NASA CR.

TECHNICAL REPORT

APOLLO-SOYUZ TEST PROJECT

PHOTOGRAPHIC FILM PROCESSING AND SENSITOMETRIC SUMMARY

Prepared Under

Contract NAS 9-11500 Task Order HT-114

Prepared By

Harold E. Lockwood Photoscientist

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Photographic Technology Division National Aeronautics and Space Administration Lyndon B. Johnson Space Center Houston, Texas 77058



National Aeronautics and Space Administration LYNDON B. JOHNSON SPACE CENTER Houston, Texas

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AND

SENSITOMETRIC SUMMARY

This report has been reviewed and is approved.

SUBMITTED:	Harold & Loclewood
	Harold E. Lockwood, Photoscientist
APPROVED:	Gerard E. Sauer, Manager Photo Science Office
CONCURRENCE	Denis H. G. Howe, Operations Manager
APPROVED:	Noel T. Lamar, Technical Monitor
CONCURRENCE	John R. Brinkmann, Chief

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INTRODUCTION

The Photographic Technology Division (PTD) at the NASA Lyndon B. Johnson Space Center (JSC) processed original photographic films exposed in flight during the Apollo Soyuz Test Project (ASTP). Integrated with processing of the original films were strict sensitometric controls and certification procedures established prior to the flight.

Information relative to the processing of the 54 rolls of original ASTP flight film and sensitometric data pertinent to each of these rolls of film is included in this report.

The purposes of the report are to provide documentation which may be a useful reference on future projects and to provide investigators with sensitometric data which will permit quantitative measurements from the ASTP imagery.

FILM PROCESSING

The original ASTP photographic films were processed in compliance with controls established and tested prior to the flight. Documents JSC-09674, "Apollo Soyuz Test Project Photographic Processing Control Plan", dated May 1975 and JSC-09650, "Film Handling Procedures for Apollo Soyuz Test Project", dated June 1975 provide details of the procedures used by PTD to process the original films.

In most cases the flight films were processed as planned. There were two rolls which required postflight establishment of new controls to achieve optimum results.

Roll CXO4 was cut and processed in four different sections to allow processing corrections for one section of film which was overexposed by about 3 f-stops. A modification was made to the ASTP control for 16mm QX-807 processed in ME-4 chemistry in the Houston processor. A combination of recommendations made by Eastman Kodak (reference letter -Appendix A) and PTD testing resulted in lowering the color developer pH by 0.5 to 11.29, adding 4.0 grams per liter NaBr to the first developer and establishing the first developer time at 3 minutes, 47 seconds.

Roll CS-03 was processed to a postflight determined control to compensate for overexposure of the original film. Sensitometry was redefined to simulate the daylight ground looking exposure actually given the film. Preflight plans called for CS films to be exposed in the spacecraft interior.

The remainder of the films were processed as planned with only normal changes made in processing machine operating parameters to achieve ASTP control.

Table I, ASTP Film Processing - Sensitometry Summary, reflects the actual processing schedule used for processing original ASTP films.

TABLE I
ASTP FILM PROCESSING-SENSITOMETRY SUMMARY

ASTP ROLL #	FILM TYPE	FILM WIDTH	PROCESS MACHINE	PROCESS CHEMISTRY	DATE PROCESSED	TIME PROCESSED	TYPE OF SENSITOMETRY
CT-04	S0-242	70mm	<u> 1811 #2</u>	EA-5	7-27-75	1920	I-B, Head, Tail
CT-05	SO-242	70mm	1811 #2	EA-5	7-27-75	2040	Orig, Houston I-B, Head,Tail Orig, Houston
CT-06	SO-242	70mm	1811 #2	EA-5	7-27-75	2155	I-B, Head, Tail Orig, Houston
CT-09	SO-242	1 6mm	RAM	ME-4	7-28-75	1510	0, 19, 11000 00
CX-01	0X-807	1 6mm	RAM	ME-4	7-25-75	0800	I-B, Tail
CX-01	0X-807	1 6mm	RAM	ME-4	7-25-75	0955	I-B, Tail
CX-02	0X-807	7 6mm	RAM	ME-4	7-25-75	1110	I-B, Tail
CX-04	QX-807	1 6 m m	RAM	ME-4	8-13&14-75		I-B, Tail each
CX-0+	γν-007	1 Offilia	(4.03	(12)	0 10011 70	•	section
CX-05	QX-807	16mm	RAM	ME-4	7-25-75	1750	I-B, Tail
CX-06	QX-807	70mm	1811 #1	EA-5	7-25-75	1145	I-B, Head, Tail
0N-00	QN-007	7 ()(11)()	1011 //1	2,1,0	, , ,		Orig, Houston,
							Spectral
CX-07	QX-807	70mm	1811 # 1	EA-5	7-26-75	1750	I-B, Head, Tail
ON 07	QX OO7	, 014411	.0 "	_r. v	, 20 , 0	.,	Orig, Houston
CX-08	QX-807	70mm	1811 #1	EA-5	7-26-75	1855	I-B, Head, Tail
0X-00	QΛ-007	7 011111	1011 #1	EII O	, 10 ,0		Orig, Houston
CX-09	QX-807	70mm	1811 #1	EA-5	7-26-75	1620	I-B, Head, Tail
0/L 05	QN OO1	7 011411	1011 #1	2 5			Orig, Houston
CX-10	QX-807	70mm	1811 #2	EA-5	7-27-75	1255	I-B, Head, Tail
O/ 10	qn oor	, 0.1					Orig, Houston
CX-11	QX-807	70mm	1811 #2	EA-5	7-27-75	0555	I-B, Head, Tail
ολ 11	QA 007	7 031413	1011 #4	21. 5	, _, .,	•	Orig, Houston
CX-12	QX-807	70mm	1811 #1	EA-5	7-25-75	1250	I-B, Head, Tail
ON 12	Q	, 0			, ,		Orig, Houston
CX-13	QX-807	70mm	1811 #2	EA-5	7-27-75	0430	I-B, Head, Tail
27. 10	4 00.	,					Orig, Houston
CX-14	QX-807	70mm	1811 #2	EA-5	7-27-75	0655	I-B, Head, Tail
<i></i>	41. 007	, 0.11111		.	· • -		Orig, Houston

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ASTP ROLL #	FILM TYPE	FILM WIDTH	PROCESS MACHINE	PROCESS CHEMISTRY	DATE PROCESSEI	TIME PROCESSED	TYPE OF SENSITOMETRY
CX-15	QX-807	70mm	1811 #1	EA-5	7-27-75	1425	I-B, Head, Tail Orig, Houston
CX-16	QX-807	70mm	1811 #2	EA-5	7 -27- 75	0835	I-B, Head, Tail Orig, Houston
CX-17	QX-807	70mm	1811 #2	EA-5	7 -27- 75	0745	I-B, Head, Tail Orig, Houston
CX-18	QX-807	35mm	Hous ton	ME-4	7-27-75	17 15	I-B, Tail
CX-19	QX-807	70mm	1811 #2	EA-5	7-27-75	0155	I-B, Head, Tail Orig, Houston
CX-20	QX-807	70mm	1811 #2	EA-5	7-27-75	0300	I-B, Head, Tail Orig, Houston
CI-01	S0-168	16mm	RAM	ME-4	7-26-75	0355	I-B, Tail
CI-02	S0-168	16mm	RAM	ME-4	7-26-75	0535	I-B, Tail
CI-03	S0-168	16mm	RAM	ME-4	7-26-75	0020	I-B, Tail
CI-04	S0-168	16mm	RAM	ME-4	7-27-75	0040	I-B, TAil
CI-05	S0-168	16mm	RAM	ME-4	7-26-75	0205	I-B, Tail
CI-06	S0-168	16mm	RAM	ME-4	7-27-75	0230	I-B, Tail
CI-07	SO-168	76mm	RAM	ME-4	7-27-75	0410	I-B, Tail
CI-08	S0 - 168	16mm	ram	ME-4	7-27-75	0610	I-B, TAil
CI-13	S0 - 168	35mm	Hous ton	ME-4	7-25-75	1310	I-B, Tail
CI-14	SO-168	35mm	Hous ton	ME-4	7-26-75	1700	I-B, Tail
CI-15	S0-168	35mm	Hous ton	ME-4	7-26-75	1830	I-B, Tail
CI-16	S0-168	35mm	Hous ton	ME-4	7-26-75	1530	I-B, Tail
CI-17	S0-168	35mm	Hous ton	ME-4	7 - 25 -7 5	1500	I-B, Tail
CI-18	S0-168	35mm	Houston	ME-4	7-26-75	1945	I-B, Tail
CI-20	SO168	35mm	Houston	ME-4	7-26-75	0910	I-B, Tail
CI-25	S0-168	16mm	ram	ME-4	7-27-75	0910	I-B, Tail
CI-26	S0-168	16mm	RAM	ME-4	7-27 - 75	0745	I-B, Tail
CI-27	SO-168	16mm	RAM	ME-4	7-27-75	1055	I-B, Tail
CI-28	S0 - 168	76mm	RAM	ME-4	7-27-75	1230	I-B, Tail
CI-29	S0 - 168	1 6mm	RAM	ME-4	7-27-75	1405	I-B, Tail

ASTP ROLL #	FILM TYPE	FILM WIDTH	PROCESS MACHINE	PROCESS CHEMISTRY	DATE PROCESSED	TIME PROCESSED	TYPE OF SENSITOMETRY
CS-01 CS-02 CS-03 CT-01	QX-806 QX-806 QX-806 SO-242	76mm 76mm 35mm 76mm	RAM RAM Houston RAM	ME-4 ME-4 ME-4 ME-4	7-25-75 7-25-75 9-3-75 7-28-75	2100 2240 0930 1345	I-B, Tail I-B, Tail I-B, Tail I-B, Head, Tail
CT-02	SO-242	70mm	1811 #2	EA-5	7–27–75	1625	Orig, Houston I-B, Head, Tail Orig, Houston Spectral
CT-03	SO-242	70mm	1811 #2	EA-5	7-27-75	1745	I-B, Head, Tail Orig, Houston
IF-01	2443	70mm	1811 #1	EA-5	7-27-75	1 530	I-B, Head, Tail
IF-02	2443	70mm	1811 #1	EA-5	7-27-75	1630	Orig, Houston I-B, Head, TAil Orig, Houston Spectral
IR-01	SO-289	70mm	11C-M #1	MX-641	7-28-75	1135	I-B, Head, Tail Orig, Houston
IR-02	SO-289	70mm	11C-M #1	MX-641	7-28-75	1600	I-B, Head, Tail Orig, Houston

^{*} Roll CX-04 was processed in four (4) each sections.

SENSITOMETRY

Sensitometric data for the ASTP original films are included in Appendices B, C, D. Eleven different types of sensitometric exposures were used for calibration and control of the project's film exposure and processing. Exposure specifications are included in the reference documents and the actual exposures used for each film are recorded on the heading of each density versus log exposure curve included in this report.

The types of sensitometric exposures made on the PTD I-B sensitometer and spectrosensitometer are as follows:

I-B Original Pre: A I-B exposure was made on the head of the original roll of flight film prior to the flight in a specified position and its location was identified by punching holes in the original film. Figure I shows the location of these exposures.

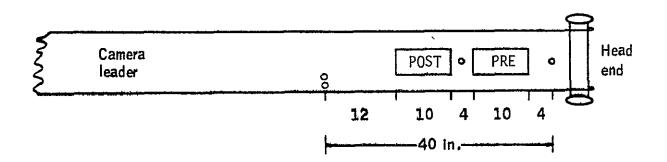


FIGURE 1 - Application of Broadband Sensitometry

<u>I-B Original Post</u>: A I-B exposure was made on the head of the original roll of flight film after the flight film was returned to PTD and prior to processing. This exposure was positioned next to the I-B original pre exposure and marked by precisely positioned punch marks.

The original pre- and postexposures may be useful in assessing changes which occur while the film is away from PTD in flight status.

I-B Houston Control Pre: A I-B exposure was made on a strip of film of the same type and emulsion number as that used for flight film and stored at room temperature within PTD facilities during the ASTP flight. Position of the exposure was marked with coded punching. Figure 2 shows the location of these exposures.

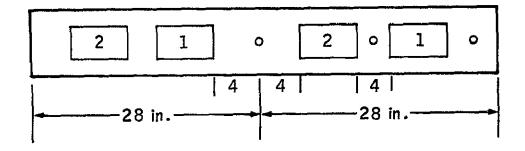


FIGURE 2 - Houston Control Sensitometry (1) Pre and postmission sensitometry using a filter simulating the mission filtration. (2) Pre and postmission spectral sensi-

tometry exposures.

The Houston Control exposures are useful in assessing the effects of spaceflight environments when the processed imagery is compared to original spaceflight film sensitometry.

<u>I-B Houston Control Post</u>: A I-B exposure was made on the same film strip as the Houston Pre exposure, positioned next to it and marked by coded punches.

I-B Certification: Five I-B exposures were made on a strip of film of the same type and emulsion number as that used for flight film. This exposed strip was processed as specified for the flight film and the results were evaluated to determine process compliance with the ASTP standards. When compliance was achieved the process was labelled "in-control" and approval was given to process the roll of flight original.

<u>I-B Head</u>: A I-B exposure was made on a strip of film of the same type and emulsion number as the flight original. This strip was physically spliced at the head end of the roll of flight original in the roll of leader and scratch test film made up for processing by PTD. Make-up of this roll is specified in JSC-09650 and shown in Figure 3.

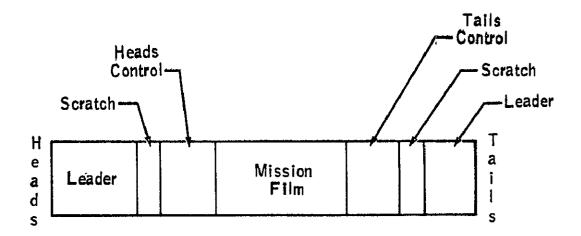


FIGURE 3 - Mission Film Configuration

<u>I-B Tail</u>: A I-B exposure was made on a strip of film of the same type and emulsion number as the flight original. This strip was physically spliced at the tail end of the roll of flight film just prior to processing by PTD. In some instances this strip served as a certification for the next roll of film scheduled for processing. In all cases the strip served as a verification of the process used for the original roll of film.

Spectral-Original Pre: One roll of each type of 70mm color film used on ASTP received spectral sensitometric exposures. Rolls CX-06, CT-02 and IF-02 received this series of exposures. This exposure was made in addition to the I-B exposures and the positions were noted with coded punches. Figure 4 shows the location of these exposures.

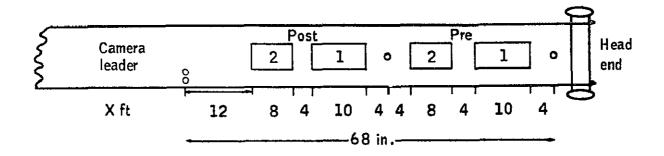


FIGURE 4 - Flight Film Sensitometry
(1) I-B Sensitometry
(2) Spectral Sensitometry

Spectral-Original Post: A spectral sensitometric exposure was made on the head of the three designated original rolls of flight film after the film was returned to PTD and prior to processing. The original pre- and postexposures may be useful in assessing changes in the film spectral sensitivity which may occur while the film is in flight status away from PTD.

Spectral-Houston Pre: A spectral sensitometric exposure was made on a strip of film of the same type and emulsion number as that used for flight film and stored at room temperature within PTD facilities. Position of the exposure was marked with coded punches.

Spectral-Houston Post: A spectral sensitometric exposure was made on the same film strip as the Spectral-Houston Pre exposure at the completion of the ASTP flight.

The Spectral-Houston Control exposures may be useful in assessing the effects of spaceflight environments when the processed Houston Control imagery is compared to original spaceflight imagery.

APPENDIX A

Recommendations forwarded to PTD for processing 16mm QX-807 (SO-368 with Wratten 2A filter overcoat) in the RAM Processor such that about 3 stops effective film speed could be lost. This was necessary to compensate for in-flight film overexposure.



August 4, 1975

Mr. Dennis Howe Technicolor Graphic Services P. O. Box 58863 Houston, Texas 77058

Dear Mr. Howe:

Re: KODAK EKTACHROME MS Recording Film QX807

Three stops overexposed

At your request, we have attempted to determine some reasonable alteration to Process ME-4 that will correct some KODAK EKTACHROME MS Recording Film QX807 which was inadvertently overexposed by about three camera stops.

We have found that the following conditions return the product from 2 2/3 stops overexposed to 2 1/3 stop return with some filled in toe as described by the attached characteristic curves and pictures.

Prehardener 3 min. 55 sec. Neutralizer 35 sec.

First Developer 4 min. 12 sec. at 79F and NaBr at 5.3 g/l.

First Stop 35 sec.

All other Process specifications

were retained as recommended in our processing manual.

These conditions were obtained as given in the attached procedure A. - Other suggestions are given in procedures B and C.

Also, enclosed are some normally exposed and 2 2/3 over-exposed sensitometric strips for your use. These exposures were made on the QX807 that you supplied to us.

We hope that the above information will at least give you a starting point for your own experimentation with your

Mr. Dennis Howe--2 August 4, 1975

equipment. If you have any questions, please contact us again through Frank Reinking.

Sincerely,

Paul J. Mutter

Motion Picture and Audiovisual

Markets Division

PJM:jpf Enc.

cc: Mr. F. R. Reinking

Procedures for Pulling 7256

- Al. Rethread or lower racks in the prehardener to obtain as much prehardener time as possible.
- 2. Lower the first developer temperature to about 80 F.
- 3. Add 4 g/l of NABR to the first developer tank. (Use as little replenisher as possible after this addition since replenishment will significantly lower the bromide level in the tank.)
- 4. Slow the machine down by about 15% to obtain more prehardener and first developer time. Return the machine to make the first Stop Suth.

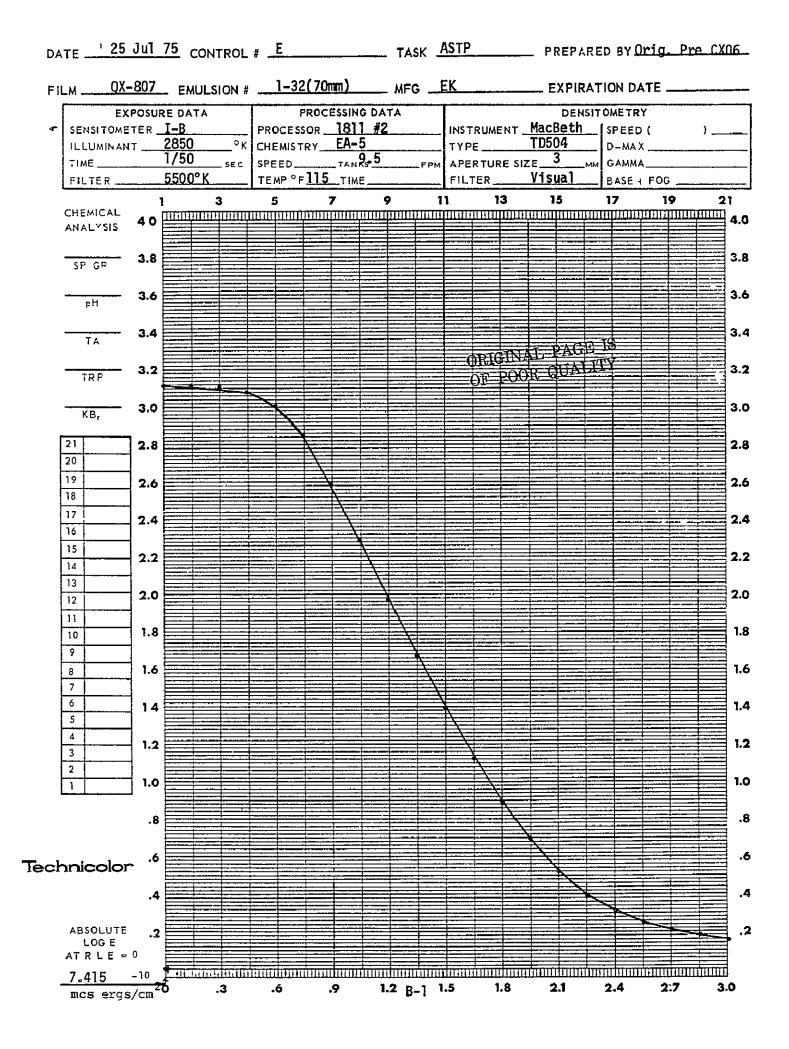
 B. If the process is still not pulled back enough and the toes are not filled in to an unacceptable level, the following procedures can be tried:
 - 1. It is preferable to lower the first developer temperature rather than decreasing the first developer time. (The lowest temperature-longest time developer possible will probably give the best result...)
 - 2. More NABR can be added to the first developer, however, additional bromide will tend to fill in the toes but not as rapidly as decreasing time or temperature.
 - C. If the process is too slow or the toes are filled in to an unacceptable level the first developer time should be increased. If this is not possible then the first developer temperature can be increased.

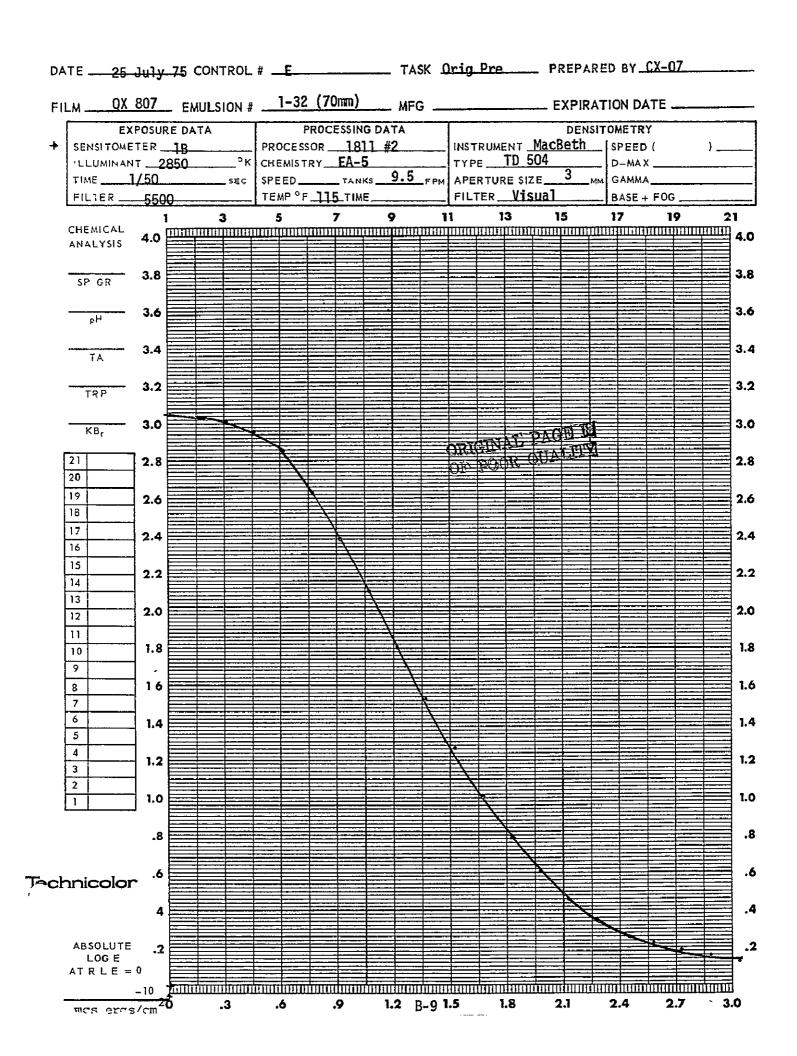
Photographic Technology Division Process 176-94 Sens. Den Status Test No. Test
Macic No. 3980 fill K Int Anal Test Time Off 1/2 xp. time sec. Read by Test Date NORMAL Exposure for 7.
Normal Exposure for 7.
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NORMAL EXPOSURE FOR 7:
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APPENDIX B

ORIGINAL PRE AND POST

I-B SENSITOMETRIC CURVES





6.

mcs ergs/cm

.9

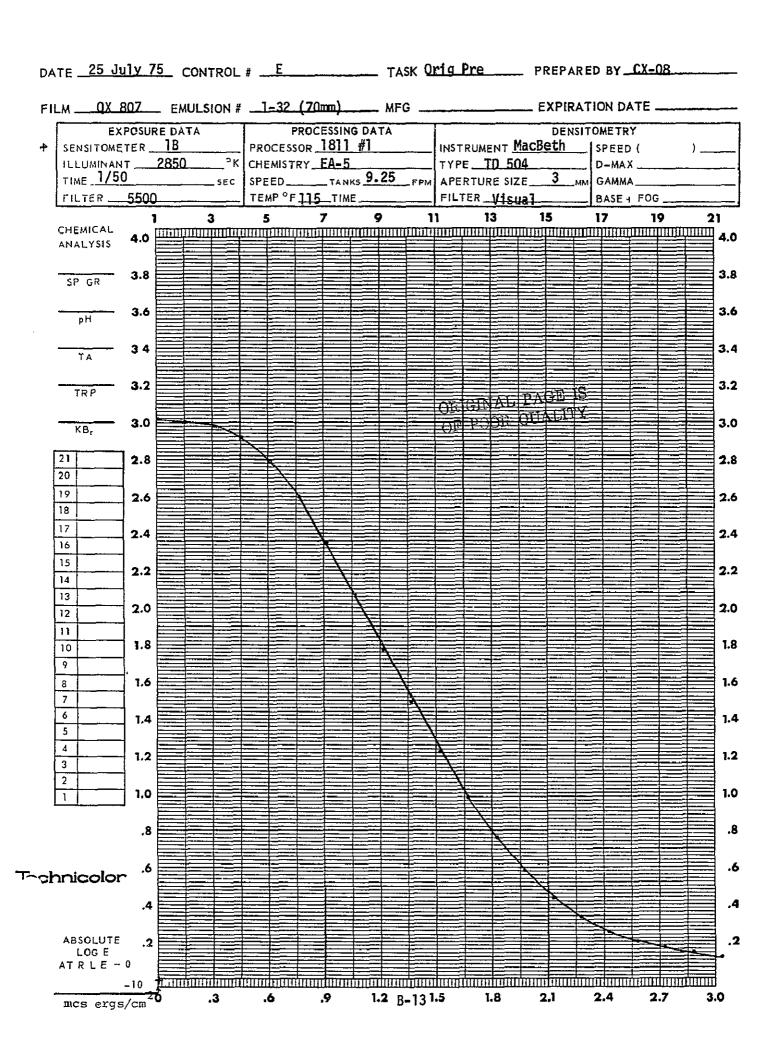
1.2 B-121.5

1.8

2.1

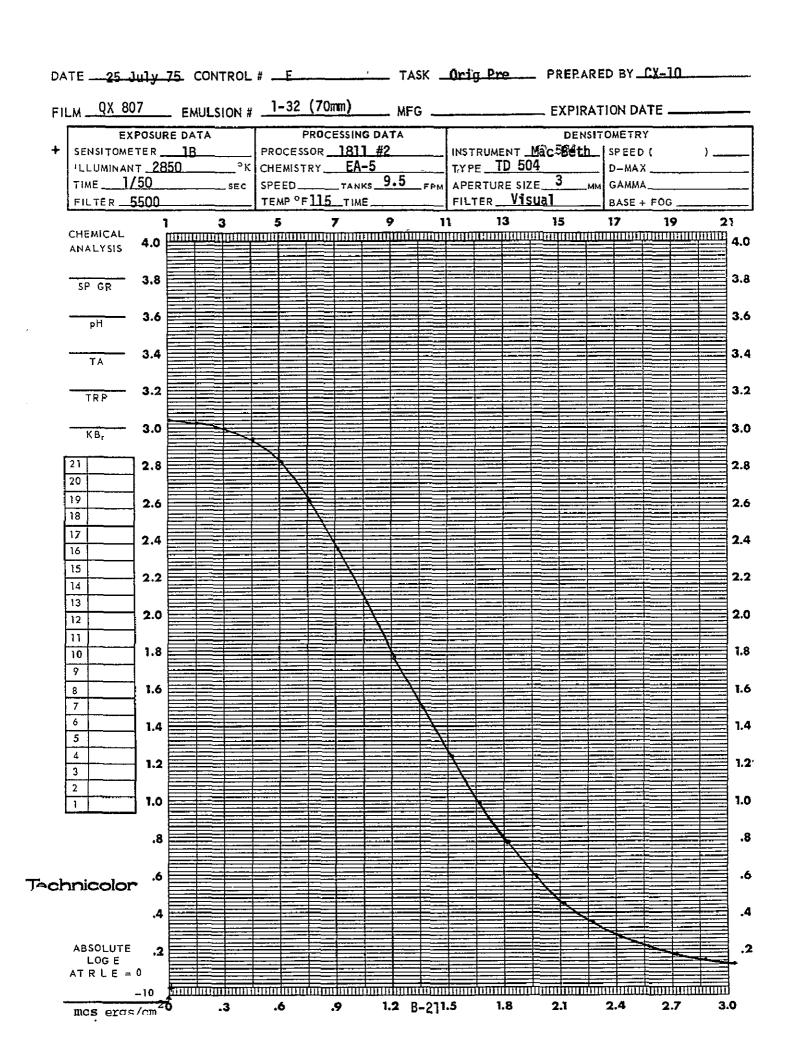
2.4

2.7



DATE 25 July 75 CONTROL # E TASK Orig Post PREPARED BY CX-08 FILM __QX_807_ EMULSION # __1_32_(70mm) ___ MFG __ _____ EXPIRATION DATE ____ EXPOSURE DATA PROCESSING DATA DENSITOMETRY PROCESSOR ____1811 #1 INSTRUMENT MacBeth | SPEED (SENSITOMETER __ 1B_ ILLUMINANT 2850 2K CHEMISTRY EA-5 D-MAX __ APERTURE SIZE 3
FILTER Status A TIME 1/50 SEC MM GAMMA_ BASE - FOG 5 7 11 13 1 15 17 CHEMICAL ANALYSIS 3.8 3.8 SP GR 3.6 3.6 ρH 3.4 3.4 TA 3.2 3.2 TRP 3.0 3.0 KB, 21 2.8 2.8 20 10 2.6 2.6 18 17 2.4 2.4 15 15 2.2 2.2 14 BLUE = 13 2.0 2.0 12 11 RED 1.8 1.8 10 GREEN 9 1.6 1.6 8 7 6 1.4 1.4 5 4 1.2 1.2 3 2 1.0 1.0 .8 .8 ٠6 Technicolor .4 +R *G •B ABSOLUTE .2 LOG E AT R L E, = 0 .3 .6 .9 1.2 B-16 1.5 1.8 2.1 2.4 2.7 3.0 mcs ergs/cm²⁰

DATE 25 July 75 CONTROL # E TASK Orig Post PREPARED BY CX-09 FILM OX 807 EMULSION # 1-32 (70mm) MFG _____ EXPIRATION DATE ___ PROCESSING DATA EXPOSURE DATA DENSITOMETRY PROCESSOR __ 1811 #1 INSTRUMENT MacBeth | SPEED (SENSITOMETER ____ 1B ILLUMINANT 2850 OK CHEMISTRY FA-5 TYPE TD 504 D-MAX __ TIME 1/50 SEC SPEED TANKS 9.25 FPM APERTURE SIZE 3 MM GAMMA_ TEMP °F 115 TIME _____ FILTER ____5500__ FILTER Visual BASE + FOG _ 9 11 -13 17 CHEMICAL 4.0 ANALYSIS 3.8 3.8 SP GR 3.6 3.6 3.4 3.2 3.2 3.0 3.0 KB, 2.8 2.8 20 19 2.6 2.6 18 17 2.4 2.4 16 15 2.2 2.2 14 13 2.0 2.0 12 11 1.8 1.8 10 9 1.6 1.6 7 6 1.4 1.4 5 4 1.2 1.2 3 1.0 1.0 .8 .8 Tachnicolor ABSOLUTE .2 LOG E ATRLE = 0 annin na handang bugai ana bandan da ba -10 2.4 1.8 2.1 .9 1.2 B-191.5 mcs ergs/cm²⁰



3.0

1.2 B-241.5

ABSOLUTE

LOGE ATRLE = 0

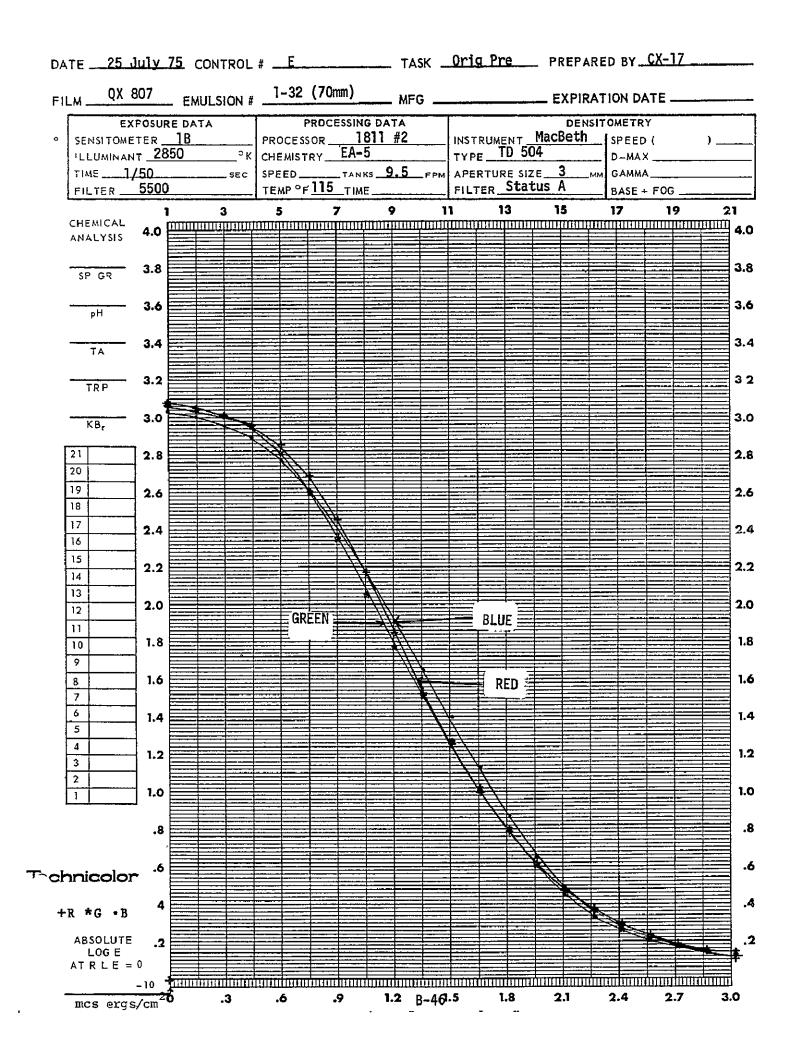
mcs ergs/cm

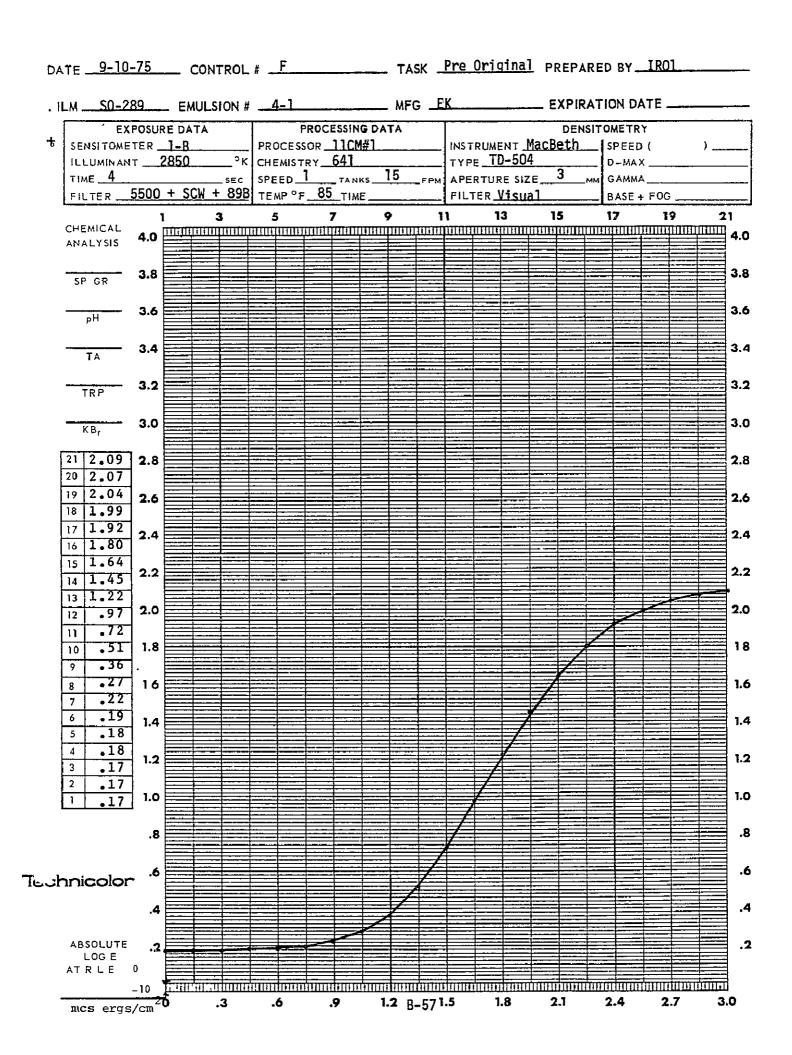
.2

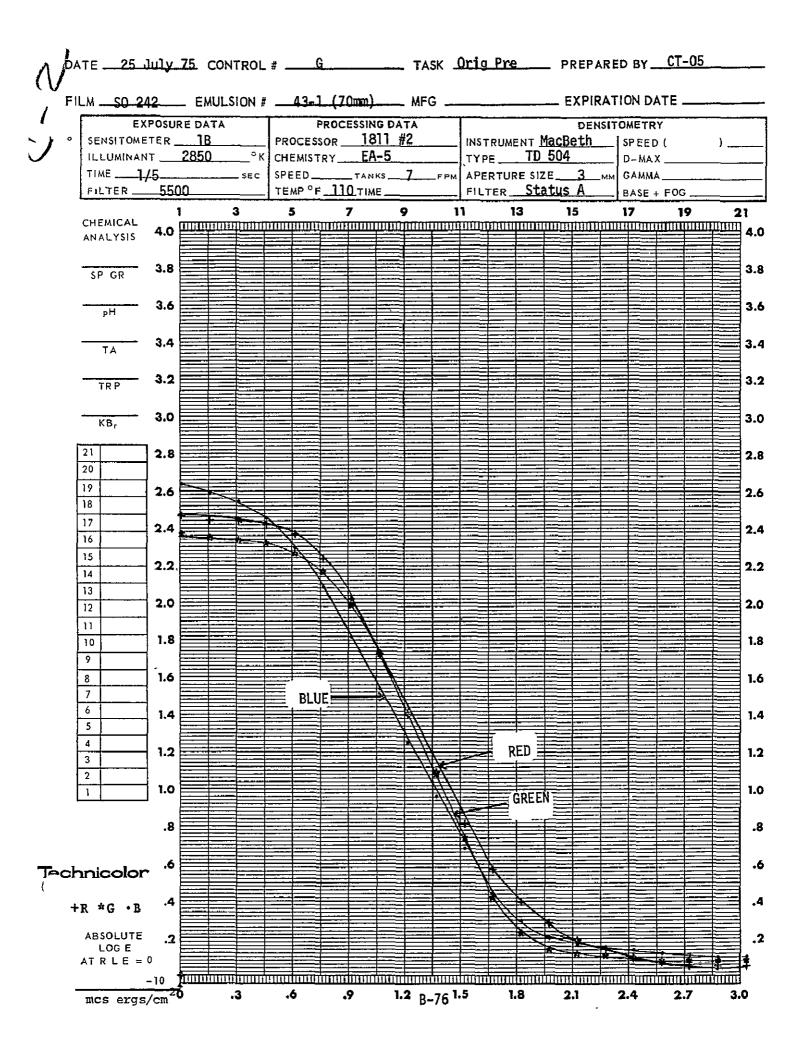
.3

DATE 25 July 75 CONTROL # E TASK Original Pre PREPARED BY CX-12

DATE _25 July 75 CONTROL # _E ____ TASK _Original Post PREPARED BY _CX-12__

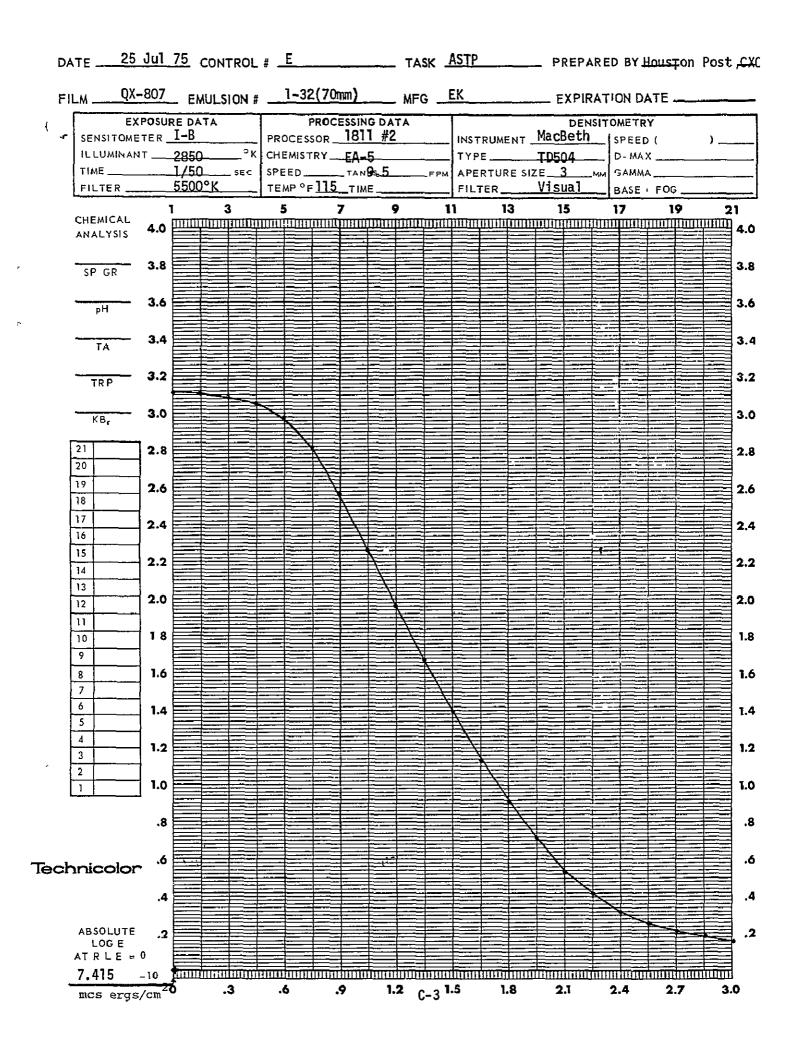






APPENDIX C HOUSTON CONTROL PRE AND POST I-B SENSITOMETRIC CURVES

DATE 1 25 Jul 75 CONTROL # E TASK ASTP PREPARED BY Houston Pre CXO 0X-807 EMULSION # 1-32(70mm) MFG EK ___ EXPIRATION DATE __ EXPOSURE DATA PROCESSING DATA DENSITOMETRY PROCESSOR 1811 #2 INSTRUMENT MacBeth | SPEED (SENSITOMETER __ I-B) ___ ILLUMINANT __ 2850 PK CHEMISTRY __ EA-5_ TYPE _____ TD504 D-MAX __ SPEED_____TAN \$.5 FILTER VISUAT TIME _____ <u>1/50</u> ____ \$E.C GAMMA_ 5500°K FILTER __ FILTER_ BASE + FOG. 11 9 - 13 15 17 CHEMICAL 4.0 ANALYSIS 3.8 3.8 SP GR 3.6 3.6 ρH 3.4 3.4 3.2 3.2 TRP 3.0 3.0 KB, 2.8 2.8 20 19 2.6 2.6 18 17 2.4 2.4 16 15 2.2 2.2 14 13 2.0 2.0 12 11 1.8 10 -1.8 8 1.6 1.6 1.4 1.2 1.2 3 1.0 \$, Technicolor .4 ABSOLUTE .2 LOG E ATRLE = 0 ուսանույլ հասանայում հասանայան հայաստանություն այլ հայաստանություն այլ հայաստանություն այլ հայաստանության այլ .6 .9 1.2 _{C-1} 1.5 1.8 2.1 3.0 .3 2.4 2.7 mcs ergs/cm



mcs ergs/cm²⁰

.6

.9

1.2 C-24 1.5

1.8

1.8

2.1

2.4

2.7

3.0

1.2 C-371.5

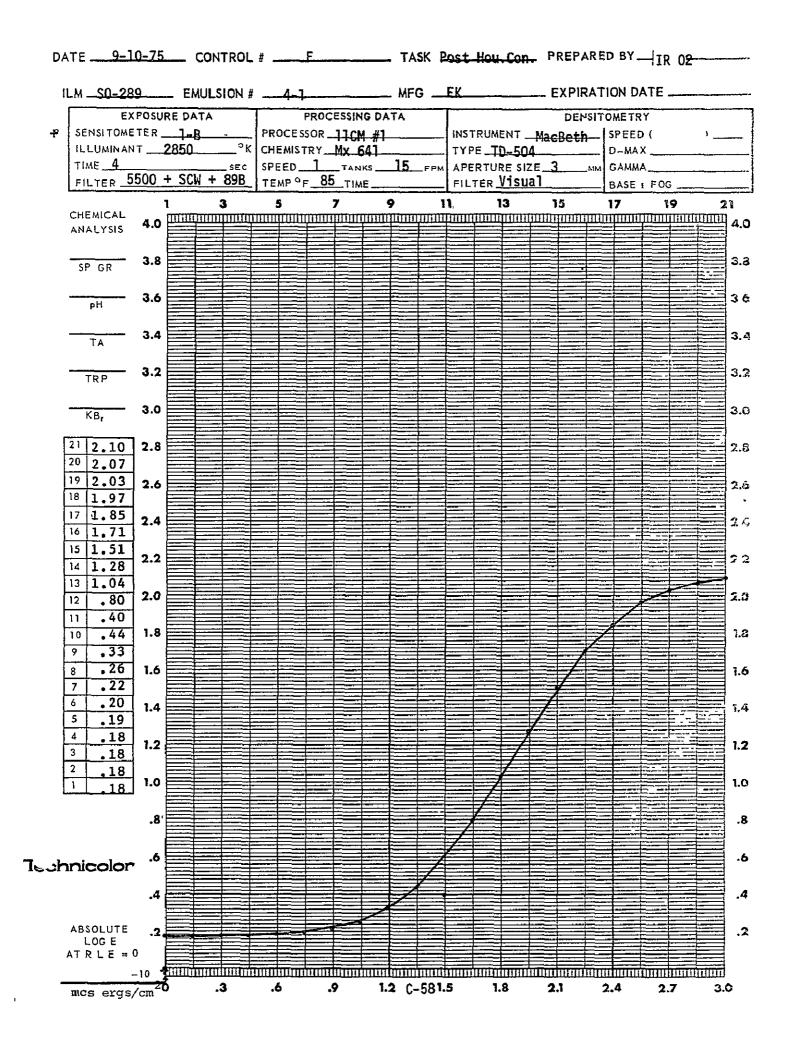
LOGE ATRLE = 0

mcs ergs/cm20

.3

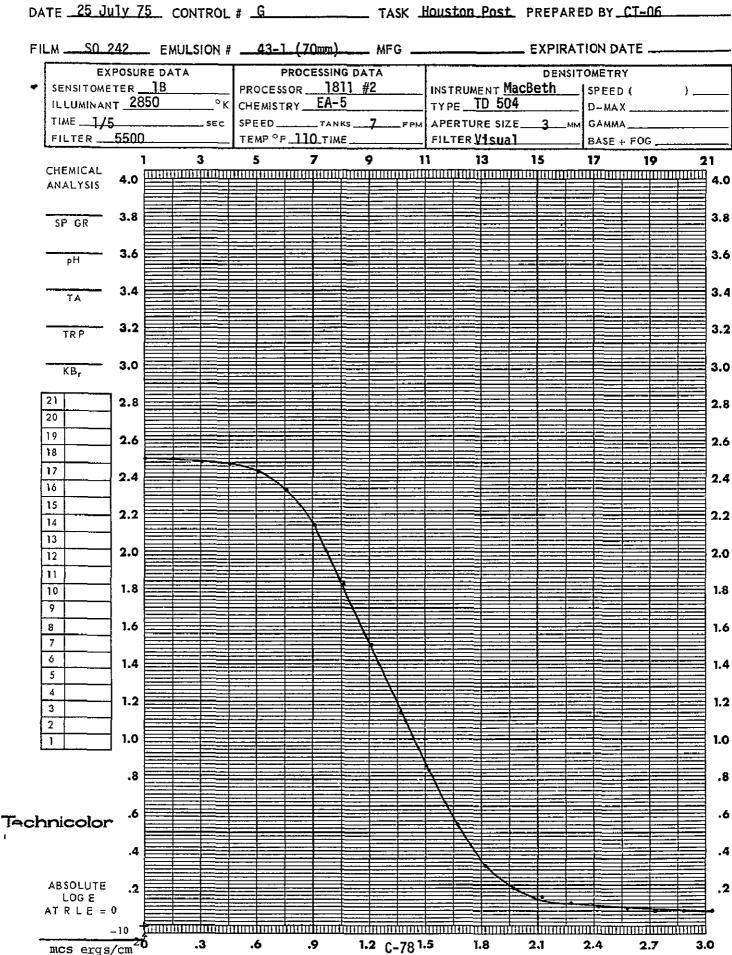
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.9



DATE 25 July 75 CONTROL # G TASK Houston Pre PREPARED BY CT-04 FILM SO 242 EMULSION # 43-1 (70mm) MFG _ _____ EXPIRATION DATE __ PROCESSING DATA EXPOSURE DATA DENSITOMETRY INSTRUMENT MacBeth PROCESSOR 1811 #2 SENSITOMETER_ 1B SPEED (ILLUMINANT 2850 PK CHEMISTRY EA-5 D-MAX __ TIME 1/5 SEC SPEED TANKS 7 FPM APERTURE SIZE 3 MM GAMMA FILTER Status A FILTER _____ 5500 TEMP of 110 TIME _____ BASE I FOG _ 13 5 7 9 11 17 19 CHEMICAL 4.0 ANALYSIS SP GR 3.8 3.8 3.6 3.5 pН 3.4 3.4 3.2 3.2 TRP 3.0 3.0 KB, 2.8 2.8 20 19 2.6 2.6 18 17 2.4 2.4 16 15 2.2 22 14 13 2.0 2.0 12 GREEN 11 1.8 1.8 10 BLUE E 1.6 1.6 ≣• RED 7 6 1.4 1.4 5 4 1.2 1.2 3 2 1.0 1.0 .8 -8 Technicolor .4 +R *G • B ABSOLUTE .2 LOG E ATRLE = 0 annisananimista kandamahan mahan mcs ergs/cm² 1.8 2.7 .3 .6 .9 1.2 C-691.5 3.0

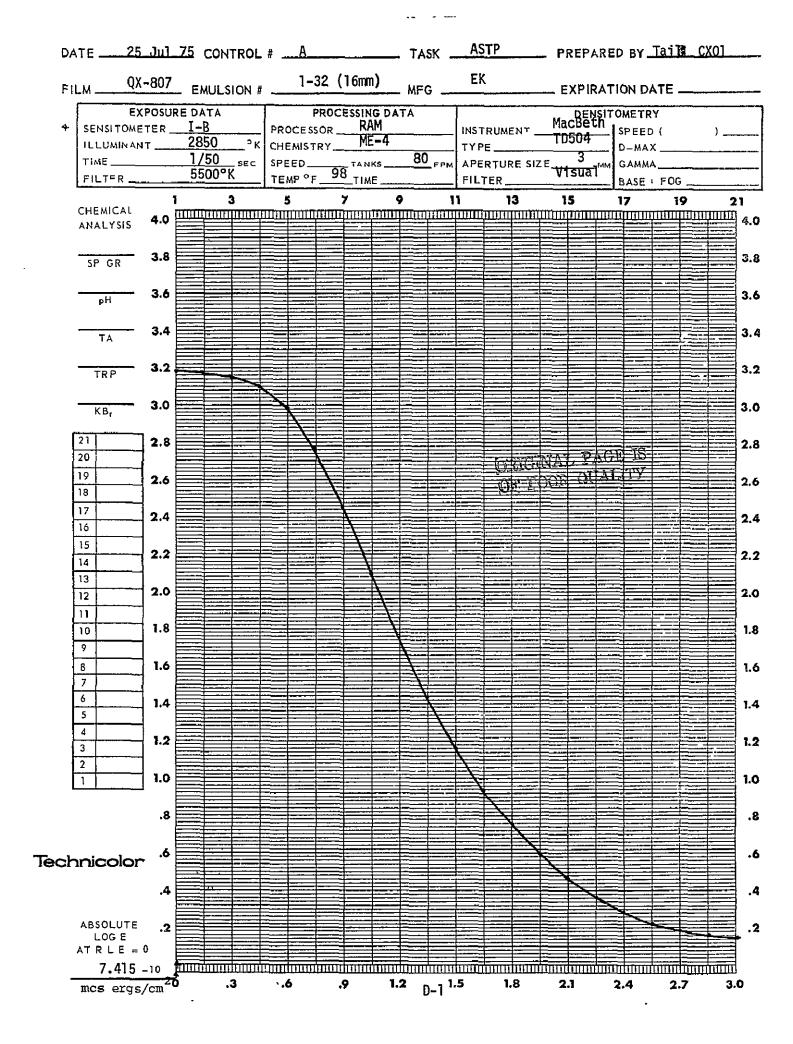
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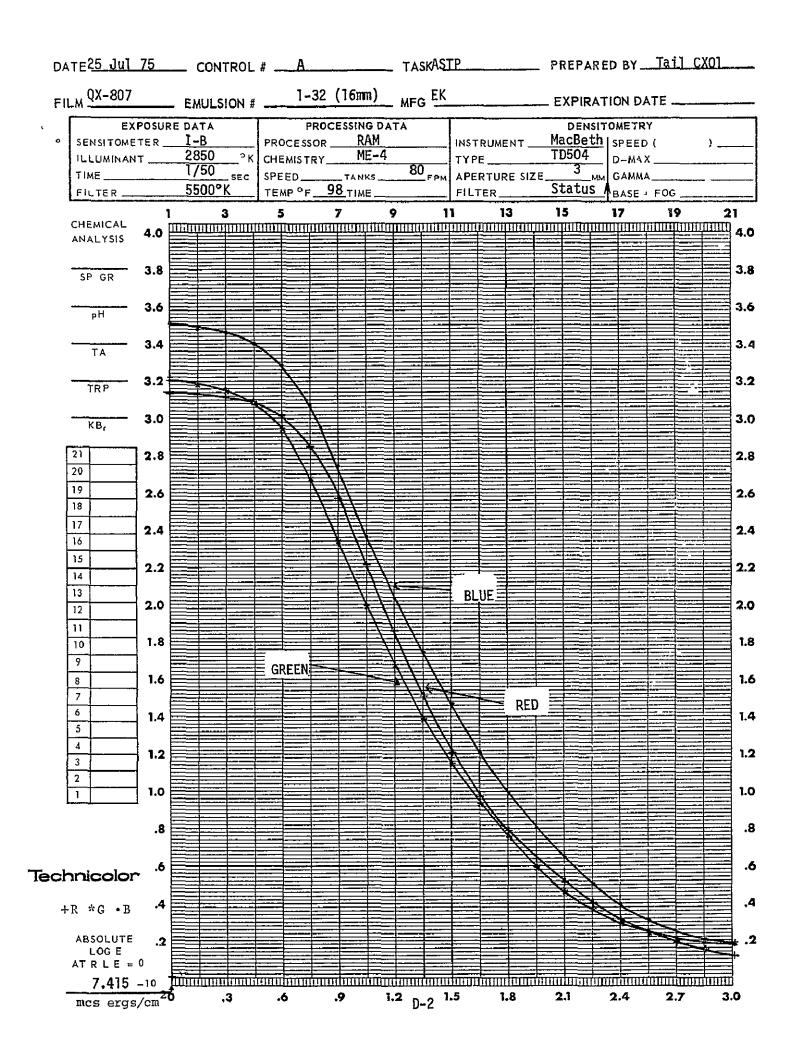


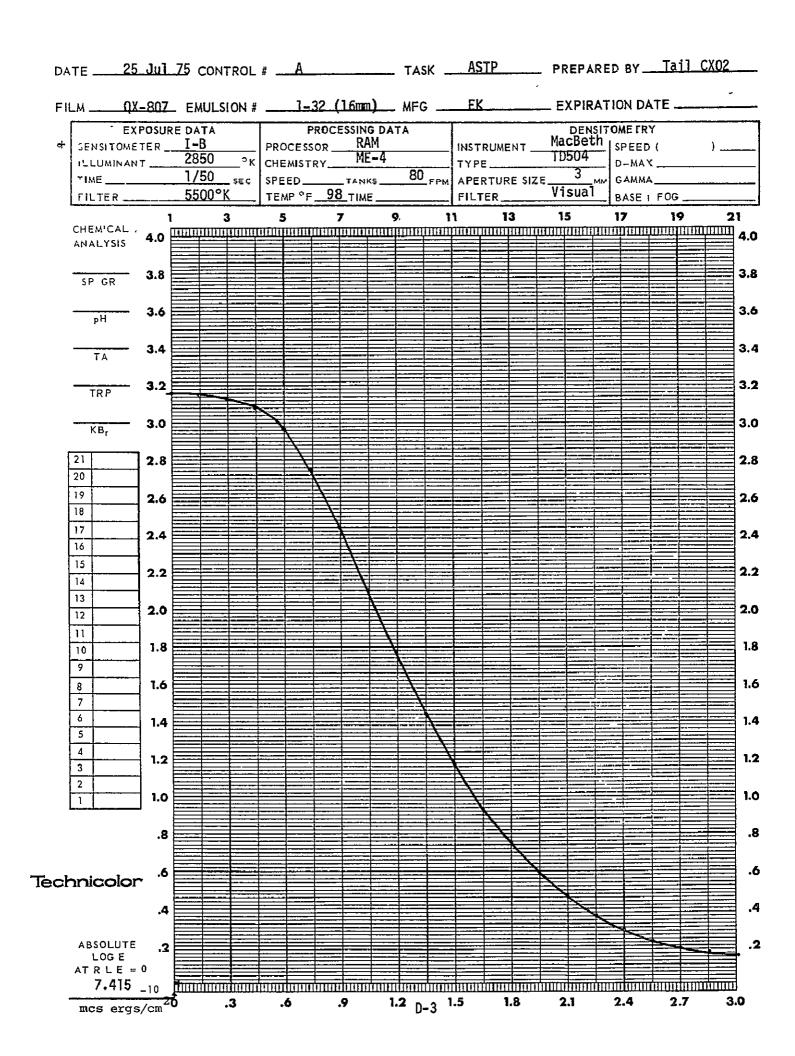
mcs ergs/cm

DATE 24 July 75 CONTROL # H TASK Houston Post PREPARED BY IF-01 _ EXPIRATION DATE _ 2443 EMULSION # ______ 206-1 (70mm) MFG _____ FILM _ PROCESSING DATA EXPOSURE DATA DENSITOMETRY SENSITOMETER __ TR PROCESSOR 1811 #2 INSTRUMENT _MacBeth | SPEED (ILLUMINANT 2850 °K CHEMISTRY FA-5 TYPE <u>TD 504</u> D-MAX ____ TIME 1/50 SEC SPEED TANKS 9.75 FPM APERTURE SIZE 3 MM GAMMA TEMP °F 115 TIME FILTER Visual FILTER 5500 + W12 BASE + FOG _ 7 9 13 15 17 11 CHEMICAL 4.0 $\frac{1}{100}$ ANALYSIS 3.8 3.8 SP GR 3.6 3.6 рΗ 3.4 3.2 3.2 TRP 3.0 3.0 KB, 21 2.8 2.8 20 19 2.6 2.6 18 17 2.4 2.4 16 15 2.2 2.2 13 2.0 2.0 12 1.8 1.8 10 9 1.6 1.6 8 7 6 1.4 1.4 5 4 1.2 1.2 3 2 1.0 1.0 8. Technicolor .4 ABSOLUTE .2 LOG E ATRLE = 0 1.2 C-82 1.5 1.8 mcs ergs/cm²⁰ .6 .9 2.1

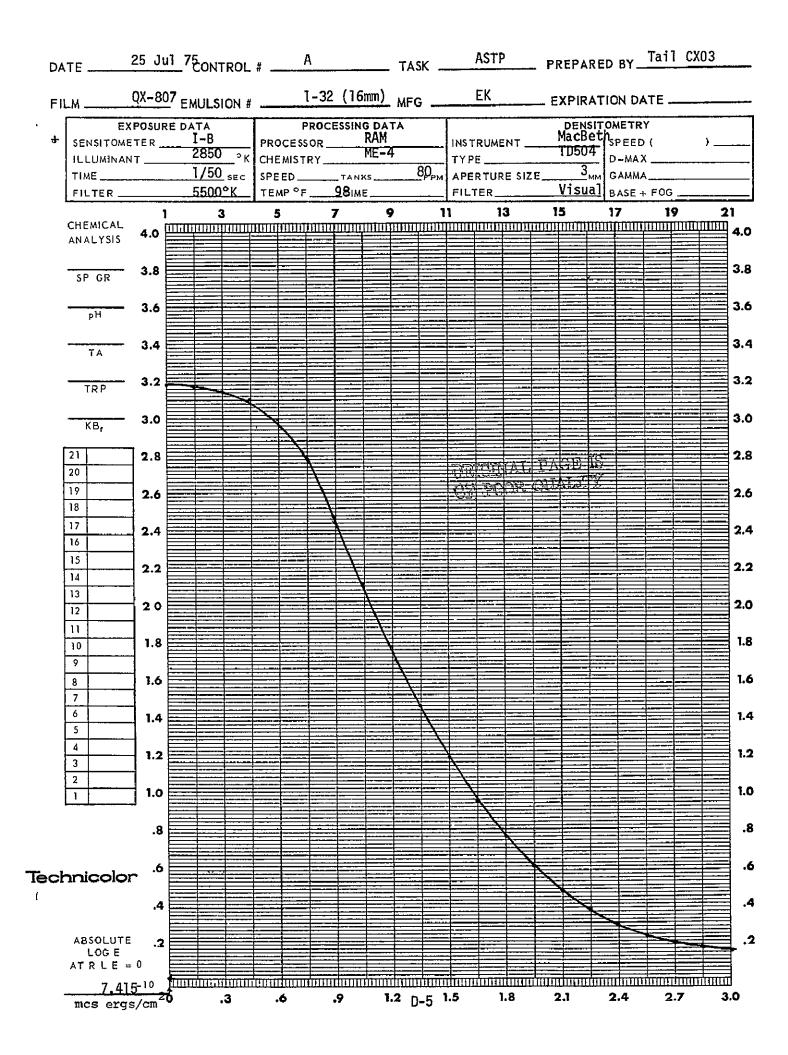
APPENDIX D HEAD AND TAIL I-B SENSITOMETRIC CURVES

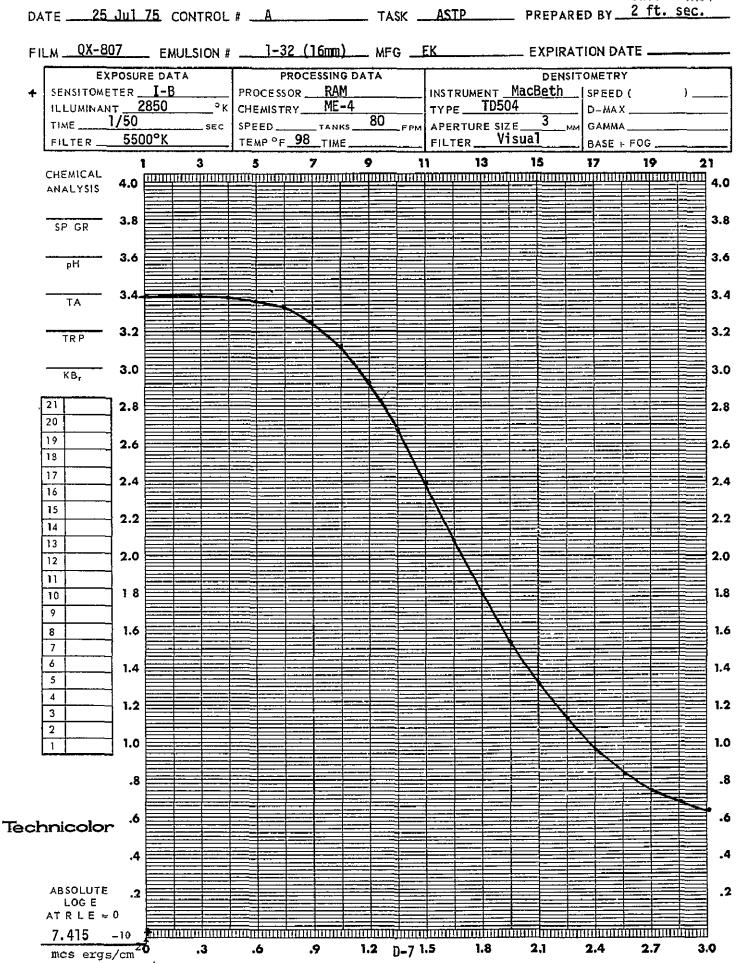


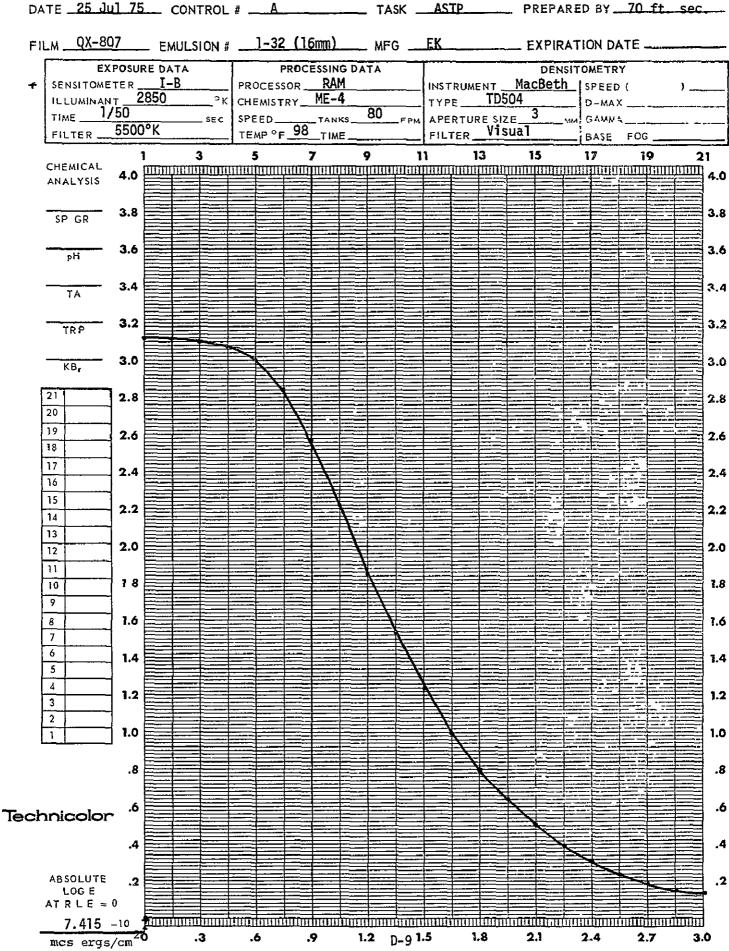




DATE25 Jul 75 CONTROL # A TASMSTP PREPARED BY Tail CX02 FILM QX-807 EMULSION # 1-32 (16mm) MFG EK ____ EXPIRATION DATE ___ EXPOSURE DATA PROCESSING DATA DENSITOMETRY PROCESSOR RAM SENSITOMETER I-B INSTRUMENT MacBeth | SPEED (ILLUMINANT 2850 TK CHEMISTRY ME-4 TYPE TD504 D MAX TIME 1/50 SEC SPEED TANKS 80 FPM APERTURE SIZE 3 MM GAMMA TEMP "F 98 TIME Status A BASE | FOG ____ HILTER 5500°K FILTER____ 7 11 13 15 CHEMICAL 4.0 $\overline{\text{comparison production production$ ANALYSIS SP GR 3.8 3.8 pH 3.6 3.6 3.4 3.4 3.2 TRP 3.0 3.0 KB, 21 2.8 2.8 20 19 2.6 2.6 18 17 2.4 2.4 16 15 BLUE 2.2 2.2 13 2.0 2.0 12 11 1.8 1.8 10 9 GREEN 1.6 8 1.6 7 RED 6 1.4 1.4 5 4 1.2 1.2 2 1.0 7.0 .8 .8 .6 Technicolor +R *G •B .4 ABSOLUTE .2 LOG E ATRLE = 0 1.2 _{D-4} 1.5 .6 1.8 2.4 2.7 mcs ergs/cm²⁰







1.8

2.7

3.0

1.2 D-10 1.5

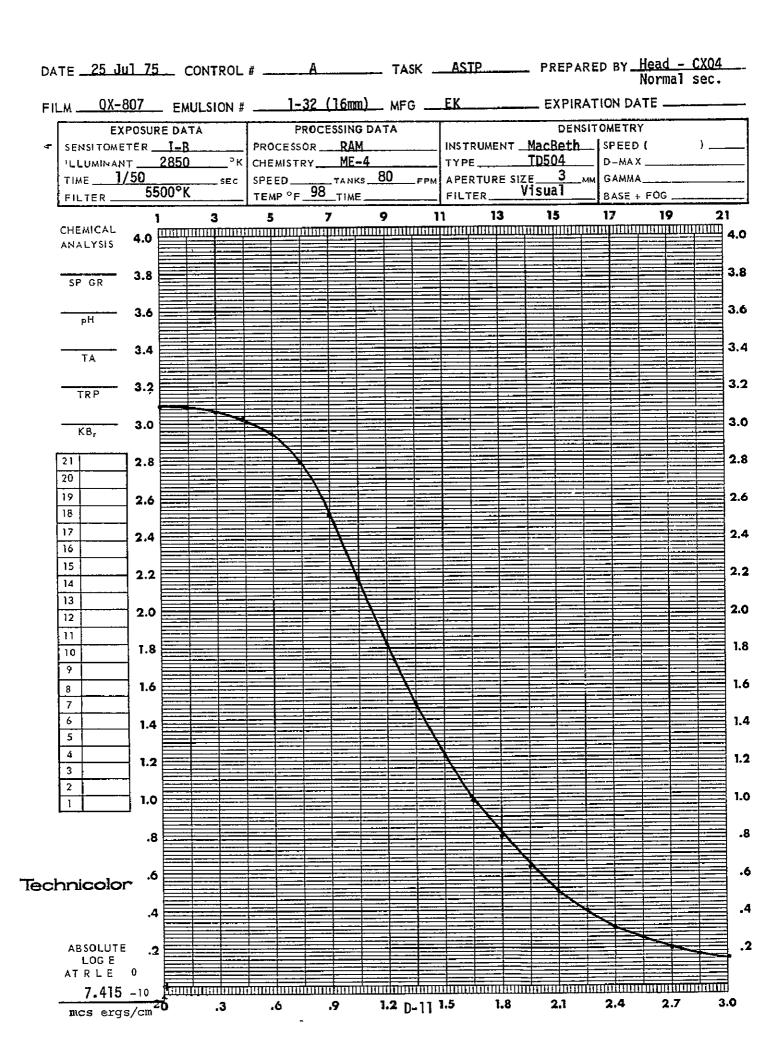
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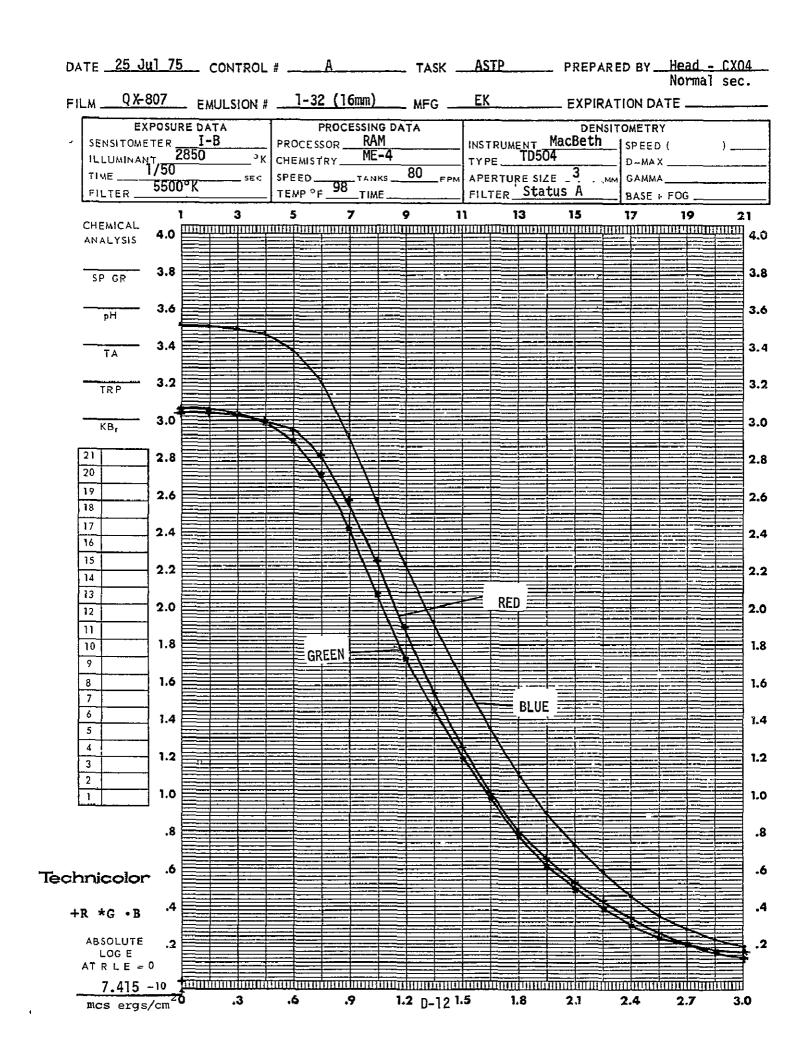
mcs ergs/cm

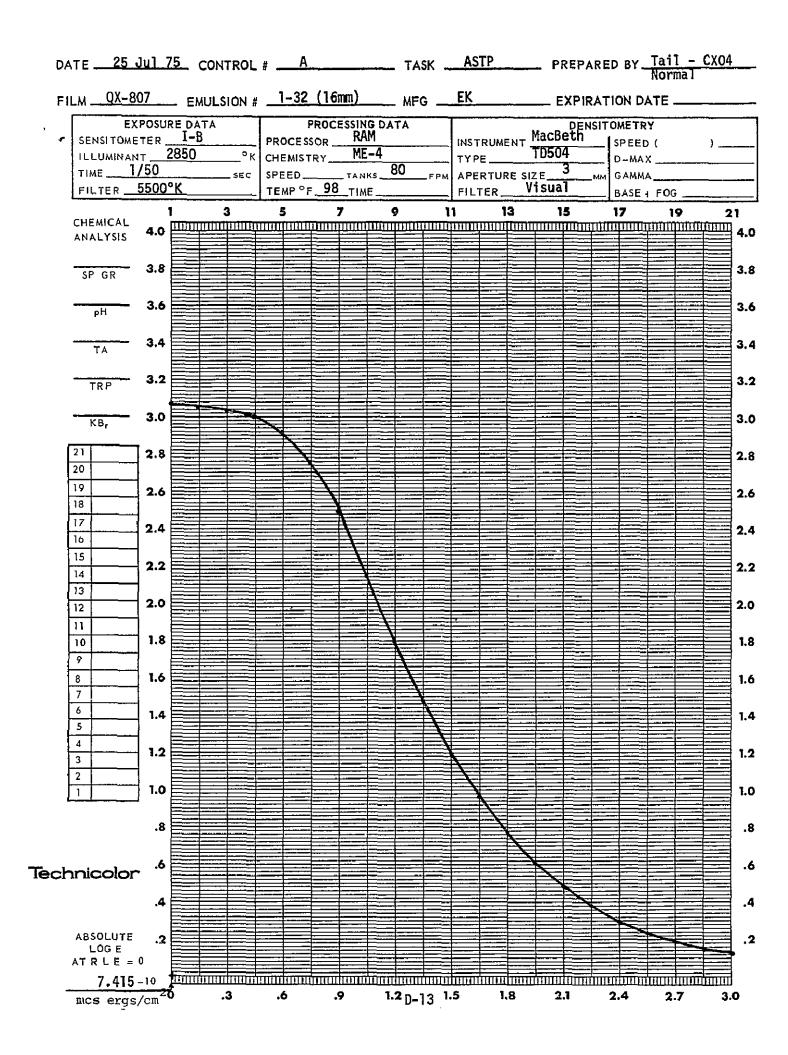
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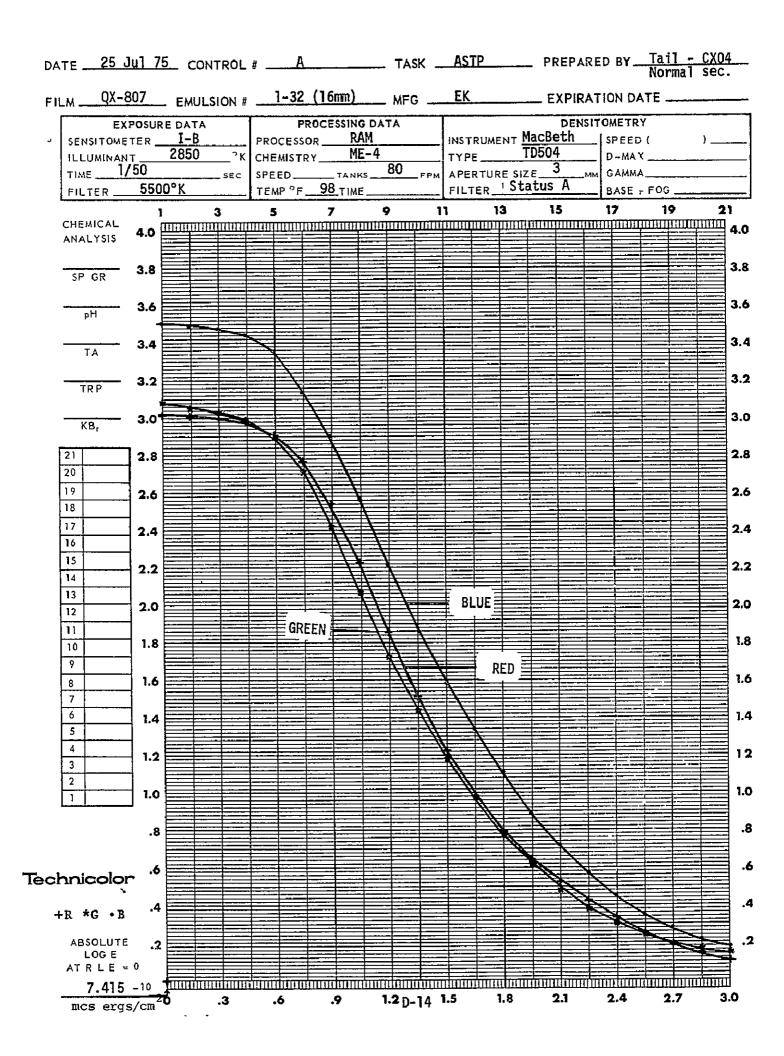
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.9









1.2 ը-16 1.5

2.1

2.4

2.7

1.8

7.415 _10

mcs ergs/cm²⁰

.6

Tail - CX04 DATE 25 Jul 75 CONTROL # A TASK ASTP PREPARED BY 35 ft. sec. FILM <u>0X-807</u> EMULSION # <u>1-32 (16mm)</u> MFG <u>EK</u> EXPIRATION DATE _ EXPOSURE DATA PROCESSING DATA DENSITOMETRY SENSITOMETER ____ I-B_ PROCESSOR RAM INSTRUMENT MacBeth | SPEED () ____ ILLUMINANT <u>2850</u> ___°K CHEMISTRY ME-4 D-MAX __ TIME _____1/50 FPM APERTURE SIZE 3 80 _ SEC | SPEED _____ TANKS ____ _MM GAMMA___ TEMP OF 82 TIME FILTER Visual BASE 4 FOG _ 11 13 17 CHEMICAL 4.0 minimum mi ANALYSIS 3.8 3.8 SP GR 3.6 3.6 ρН 3.4 3.4 3.2 3.2 TRP 3.0 3.0 KB, 21 2.8 2.8 20 19 2.6 2.6 18 17 2.4 16 15 2.2 2.2 14 13 2.0 2.0 12 1.8 1.8 10 9 1.6 8 1.6 7 6 1.4 1.4 5 4 1.2 1.2 3 1.0 1.0 8. .8 .6 Technicolor .4

1.2 D-]7 1.5

1.8

2.1

2.4

2.7

.6

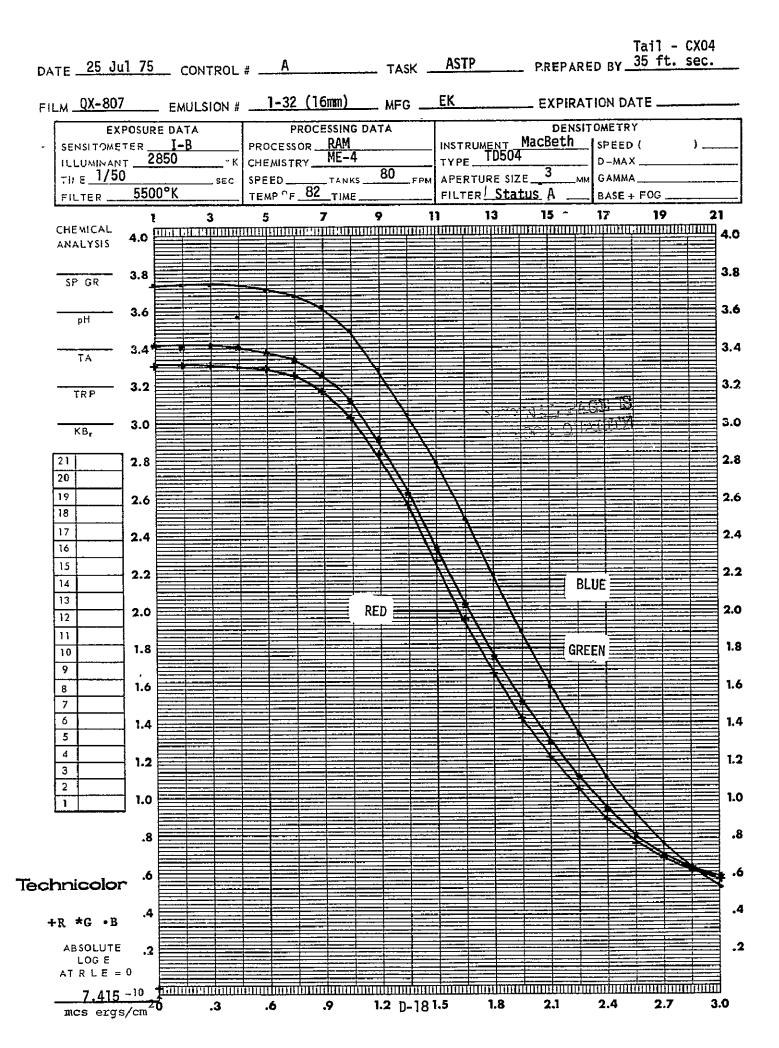
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.2

ABSOLUTE

LOG E ATRLE = 0

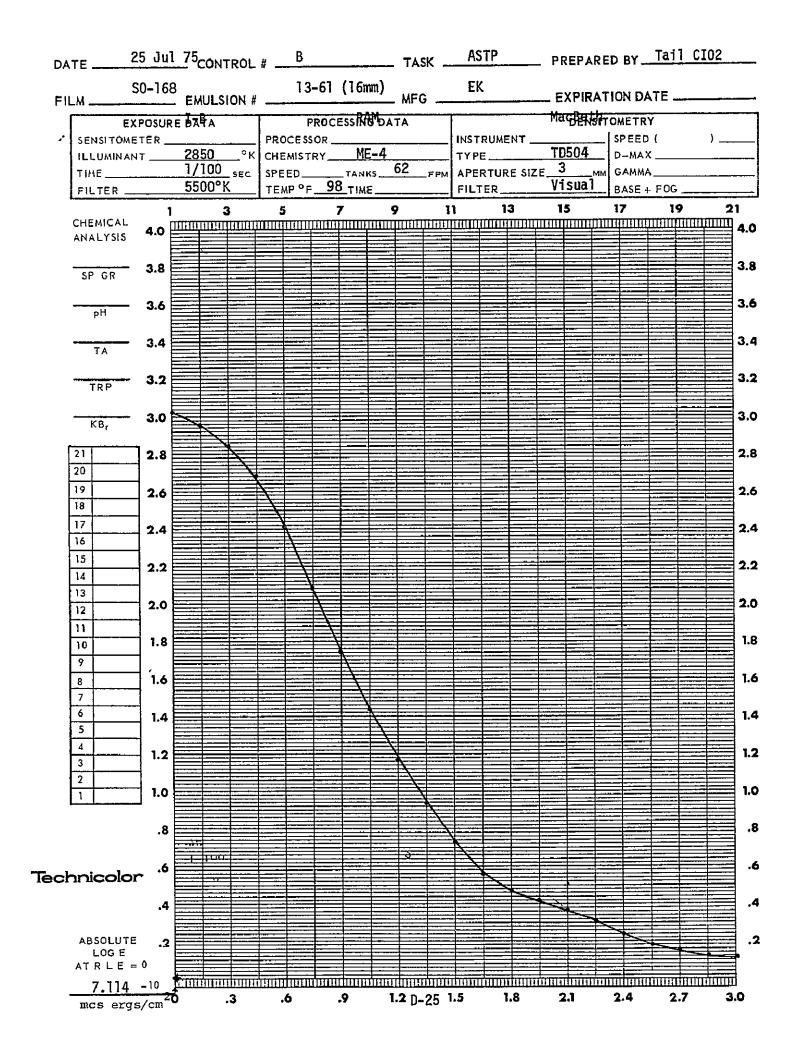
mcs ergs/cm

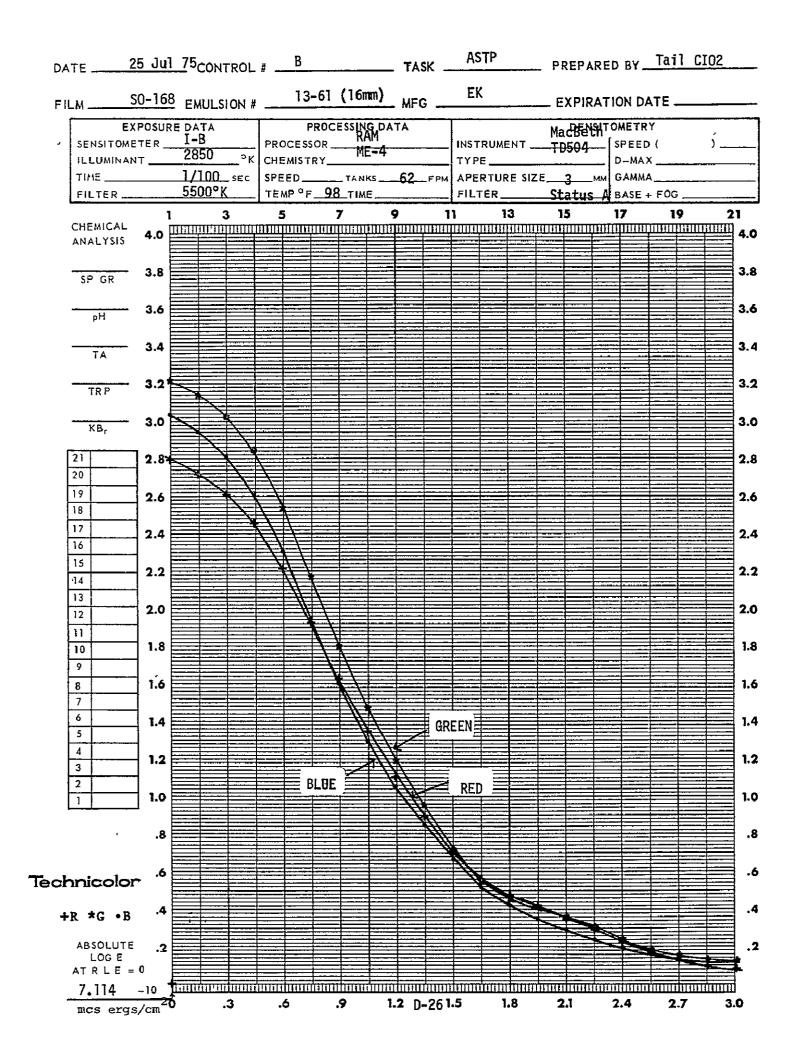


DATE 25 Jul 75 CONTROL # A TASK ASTP PREPARED BY SEC.

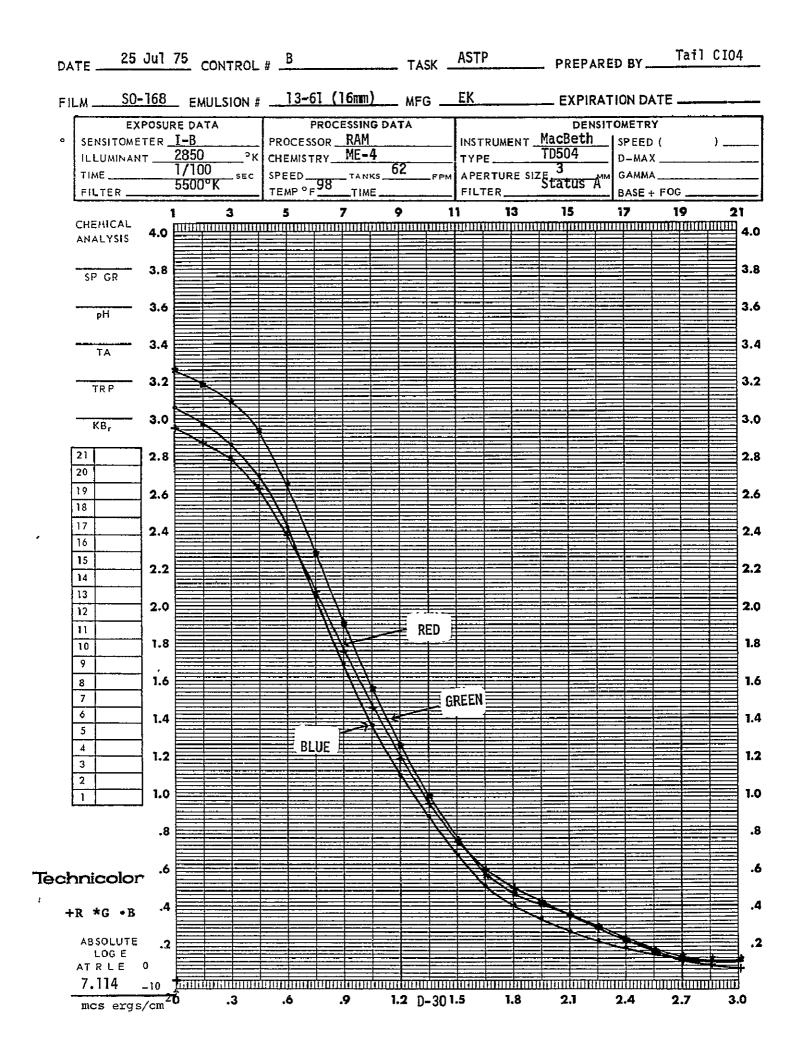
Tail 6 ft.

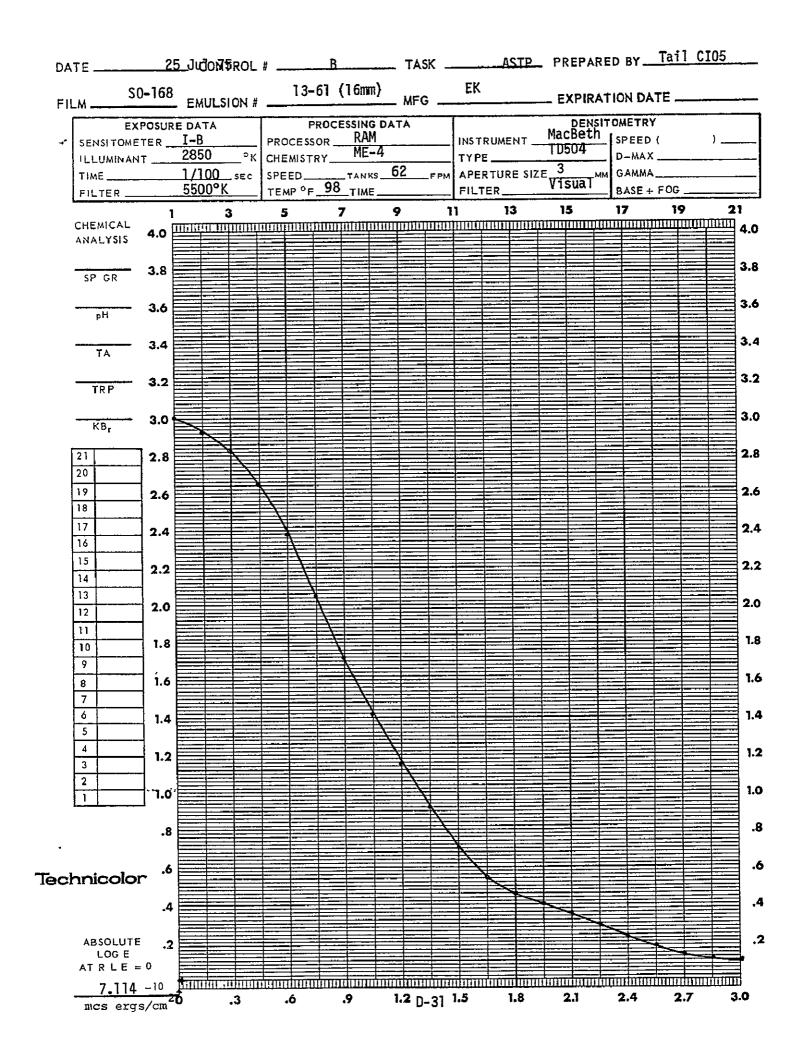
DATE 25 Jul 75 CONTROL # A TASK ASTP PREPARED BY Sec. FILM QX-807 EMULSION # 1-32 (16mm) MFG EK EXPIRATION DATE PROCESSING DATA EXPOSURE DATA DENSITOMETRY SENSITOMETER I-B PROCESSOR RAM
CHEMISTRY ME-4 INSTRUMENT MacBeth SPEED (TYPE ____ D-MAX_ APERTURE SIZE 3 TIME ___1/50 _MM GAMMA_ FILTER Status A 5500°K FILTER ____ BASE + FOG 13 CHEMICAL 4.0 ANALYSIS 3.8 3.8 SP GR 3.6 3.6 рΗ 3.4 3.4 TA 3.2 3.2 TRP 3.0 3.0 KB, 21 2.8 20 19 2.6 2.6 18 17 2.4 2.4 16 15 2.2 2.2 14 13 2.0 2.0 12 ≣ GREEN! 11 BLUE 1.8 1.8 10 9 1.6 8 1.6 7 RED 6 1.4 1.4 5 4 1.2 1.2 3 2 1.0 1.0 .8 8. .6 Technicolor +R *G •B ABSOLUTE .2 LOG E ATRLE = 0 mcs ergs/cm²⁰ .6 .9 1.2 D-20 1.5 1.8 2.1 2.4 2.7 3.0

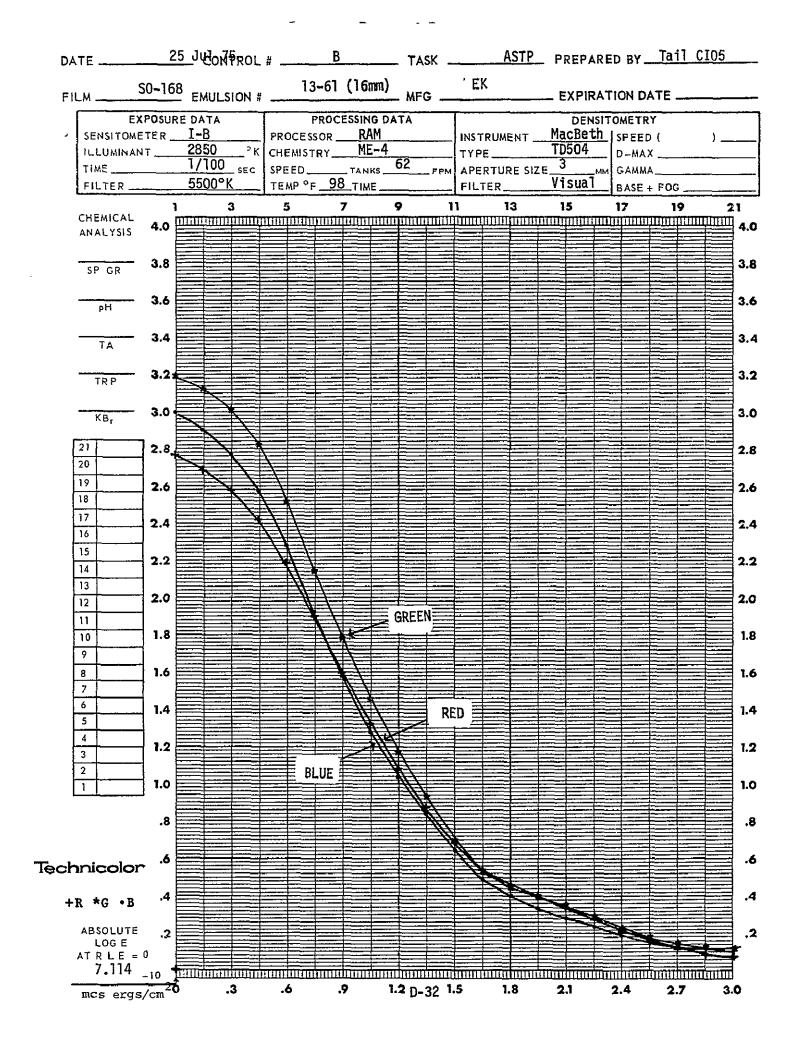


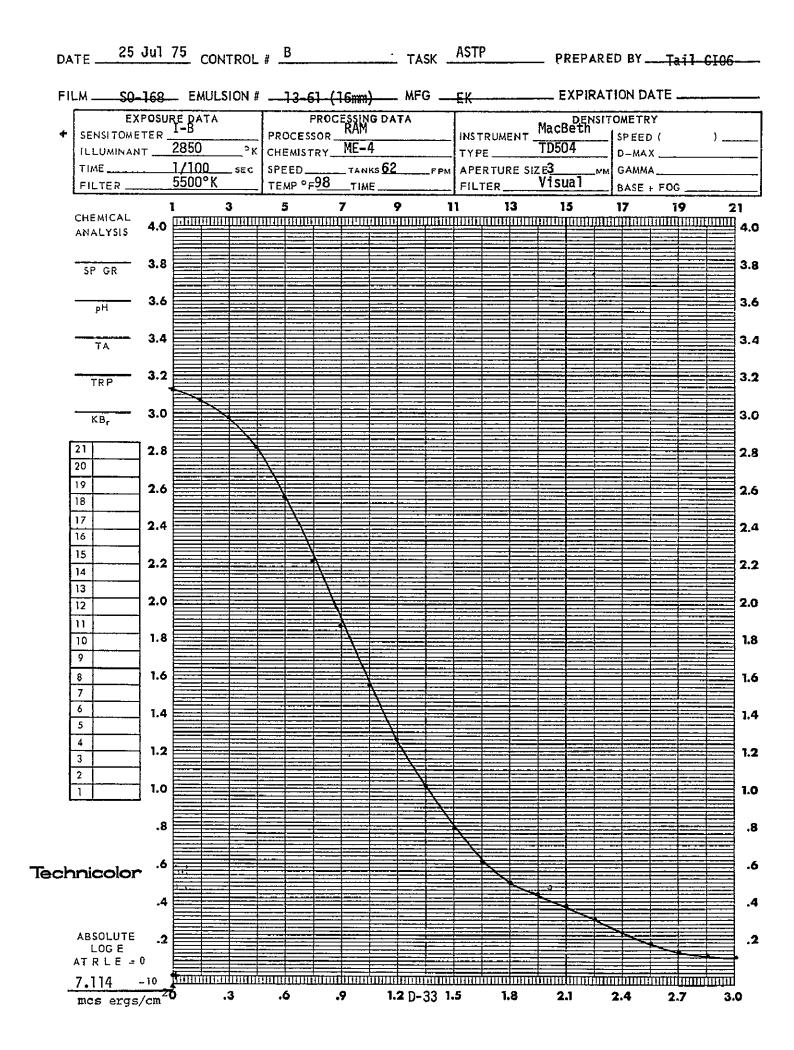


DATE 25 Jul 75 CONTROL # B TASK ASTP PREPARED BY Tail CIO3 __ EXPIRATION DATE _ EXPOSURE DATA PROCESSING DATA DENSITOMETRY INSTRUMENT MacBeth (SPEED (SENSITOMETER I-B PROCESSOR RAM) ___ ILLUMINANT 2850 PK CHEMISTRY ME-4 TYPE _____T0504_ D-MAX_ 1/100 sec SPEED TANKS 62 FPM APERTURE SIZE 3 MM 5500°K TEMP °F 98 TIME FILTER Status A GAMMA___ TIME _____ FILTER _ BASE + FOG _ 15 17 7 11 13 19 4.0 CHEMICAL ANALYSIS 3.8 3.8 SP GR 3.6 3.6 ρН 3.4 3.4 3.2 3.2 TRP 3.0 3.0 KB, 21 2.8 2.8 20 19 2.6 2.6 18 17 2.4 2.4 16 15 2.2 2.2 14 13 2.0 2.0 12 1.8 1.8 10 9 1.6 1.6 8 RED 1.4 1.4 5 BLUE 4 1.2 1.2 3 2 GREEN 1.0 1.0 .8 .8 .6 Technicolor .4 +R *G •B ABSOLUTE LOG E ATRLE - 0 andarsa basaduna dan mbana dan mahan bahan bahan dan mbana basada na bahan dan dan bana dan bahan dan bahan da 7.114 ó. 1.2 D-28 1.5 1.8 2.7 .3 .9 mcs ergs/cm20

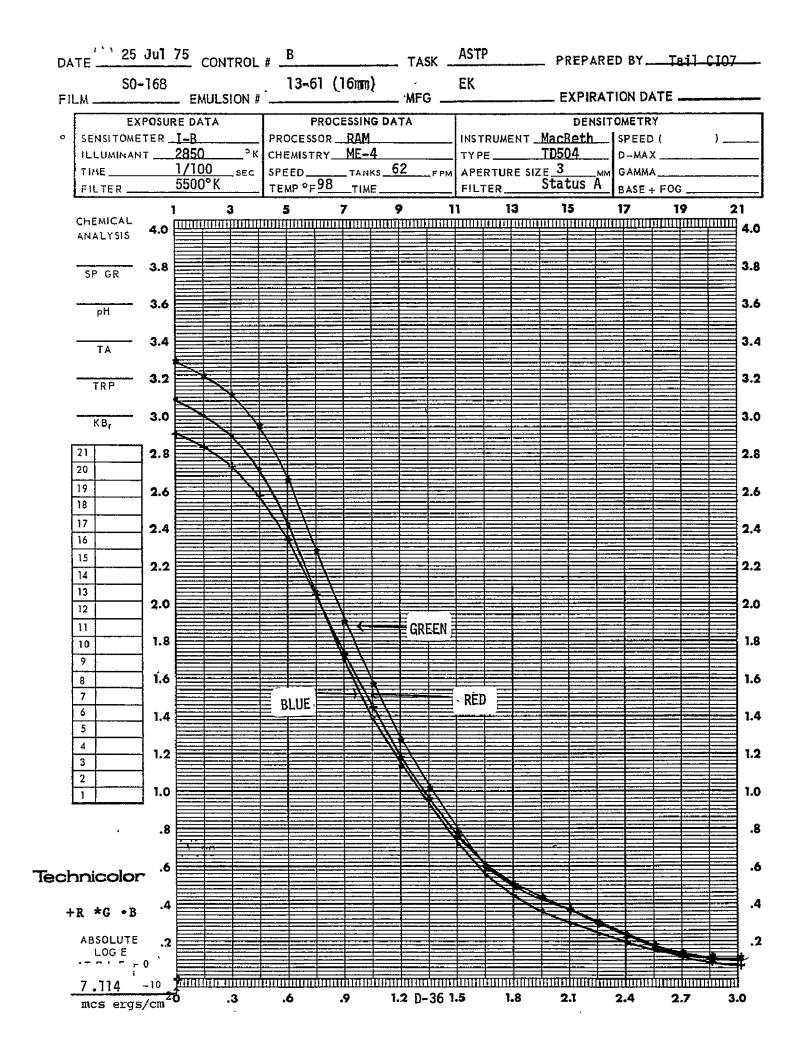






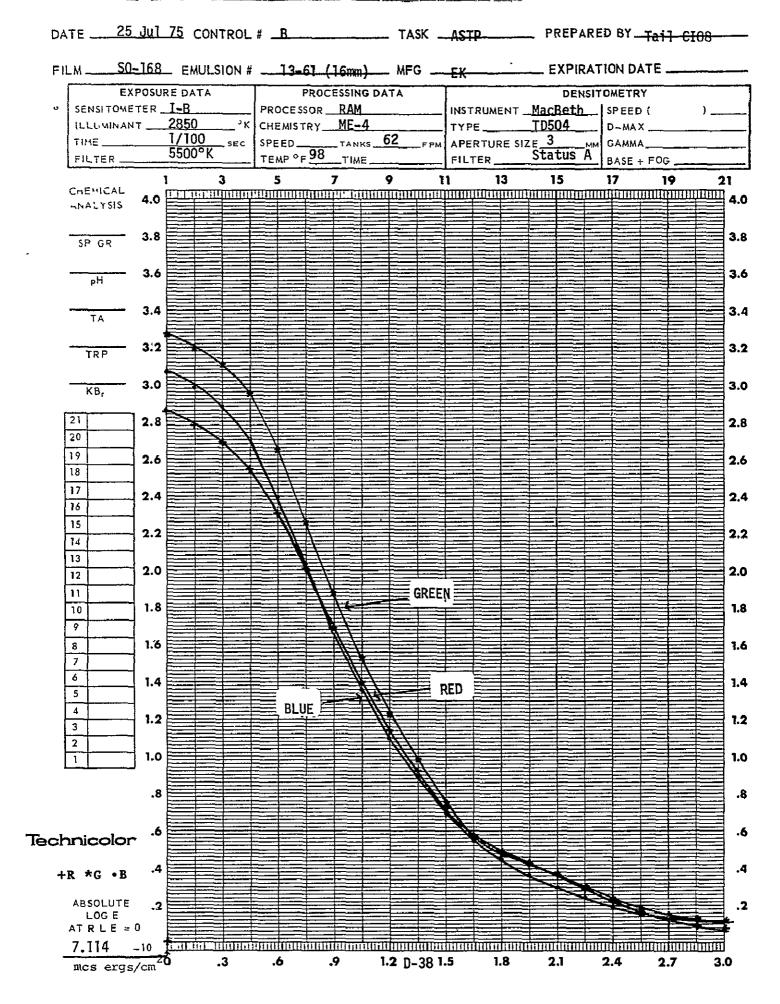


DATE 25 Jul 75 CONTROL # B TASK ASTP PREPARED BY Tail CIO6 FILM S0-168 EMULSION # 13-61 (16mm) MFG EK EXPIRATION DATE _ EXPOSURE DATA PROCESSING DATA DENSITOMETRY SENSITOMETER I-B INSTRUMENT MacBeth | SPEED (PROCESSOR RAM ILLUMINANT 2850 PK CHEMISTRY MF-4 TYPE _______TD504_____ D~MAX ___ TIME 1/100 SEC SPEED TANKS 62 FPM APERTURE SIZE 3 MM GAMMA FILTER 5500°K TEMP°F98 TIME FILTER Status A BASE : FOO BASE : FOG _ 17 11 13 15 CHEMICAL 4.0 ANALYSIS 3.8 3.8 SP GR 3.6 3.6 рΗ 3.4 3.4 3.2 3.2 TRP 3.0 3.0 KB, 21 2.8 2.8 20 2.6 2.6 18 17 2.4 2.4 16 15 2.2 2.2 13 2.0 2.0 12 11 10 1.8 1.8 GREENE 9 1.6 1.6 ≅ RED 1.4 1.4 5 4 1.2 1.2 3 BLUE 1.0 1.0 .8 .8 .6 Technicolor +R *G •B .4 ABSOLUTE .2 .2 LOG E ATRLE = 0 mcs ergs/cm²⁰ .6 .9 1.2 D-34 1.5 2.7 2.1 2.4 3.0

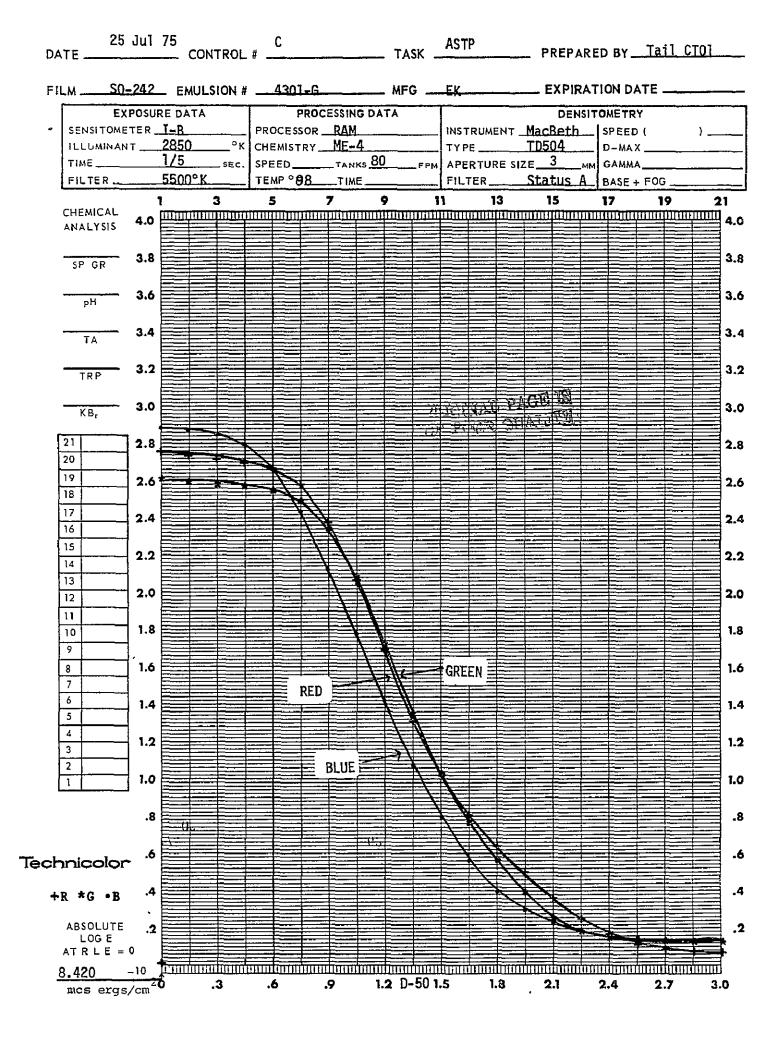


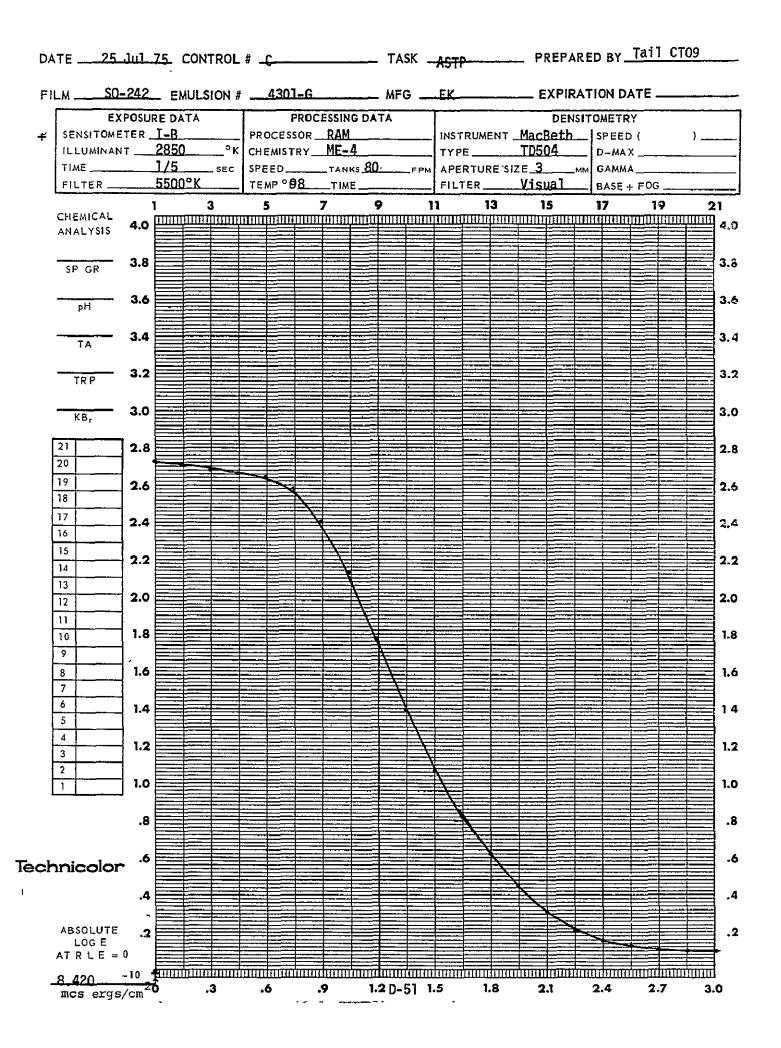
DATE 25 Jul 75 CONTROL # B TASK ASTP PREPARED BY Tail CIOS __ EXPIRATION DATE __ EXPOSURE DATA PROCESSING DATA DENSITOMETRY SENSITOMETER _I-B PROCESSOR RAM INSTRUMENT MacBeth | SPEED (ILLUMINANT ______ 2850_ ___°K CHEMISTRY <u>ME-4</u> TD504 TYPE_____ D-MAX ___ SPEED TANKS 62 TIME _______1/100 ____FPM APERTURE SIZE3___ MM GAMMA____ Visual 5500°K FILTER __ FILTER__ BASE + FOG _ 9 11 13 15 19 21 4.0CHEMICAL 4.0 ANALYSIS 3.8 3.8 SP GR 3.6 3.6 рΗ 3.4 3.4 3.2 3.2 TRP 3.0 3.0 KB, 21 2.8 2.8 20 19 2.6 2.6 18 17 2.4 2.4 16 15 2.2 2.2 14 13 2.0 2.0 12 11 1.8 10 1.8 9 1.6 8 1.6 7 6 1.4 1.4 5 4 1.2 1.2 3 2 1.0 1:0 .8 .8 ۰6 Technicolor .4 .4 ABSOLUTE 10 .2 LOG E ATRLE = 0 7.114 mcs erac/cm20 .3 .6 1.2 D-37 1.5 1.8 2.1 3.0 2.7

oration ____

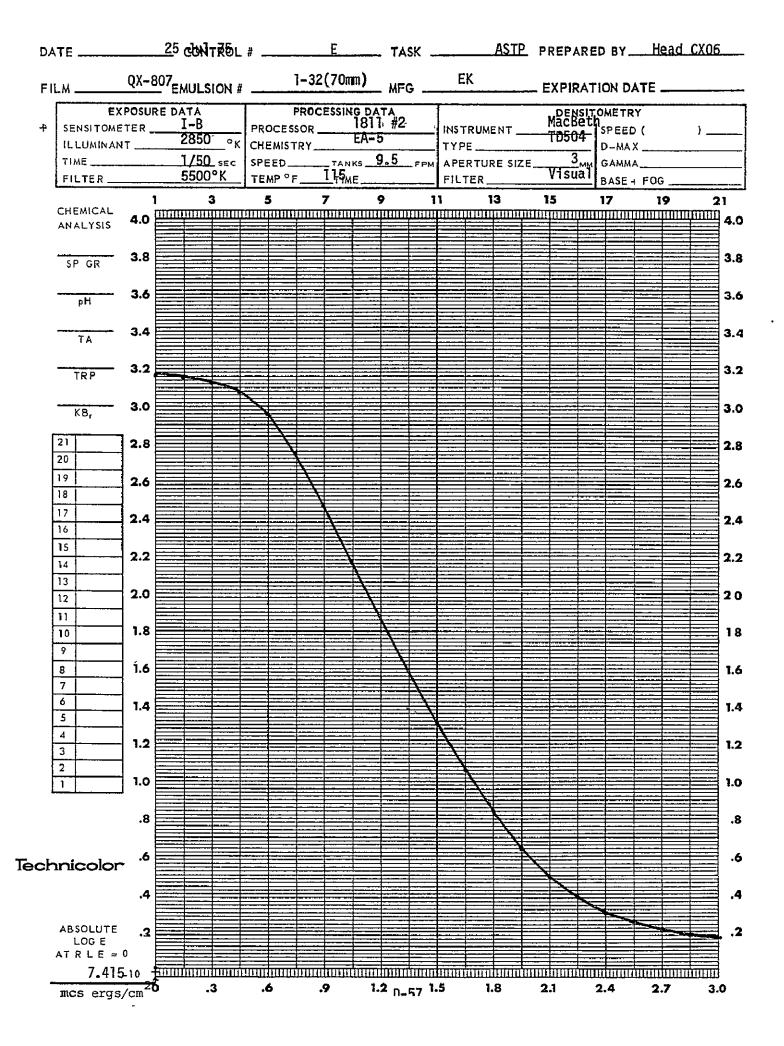


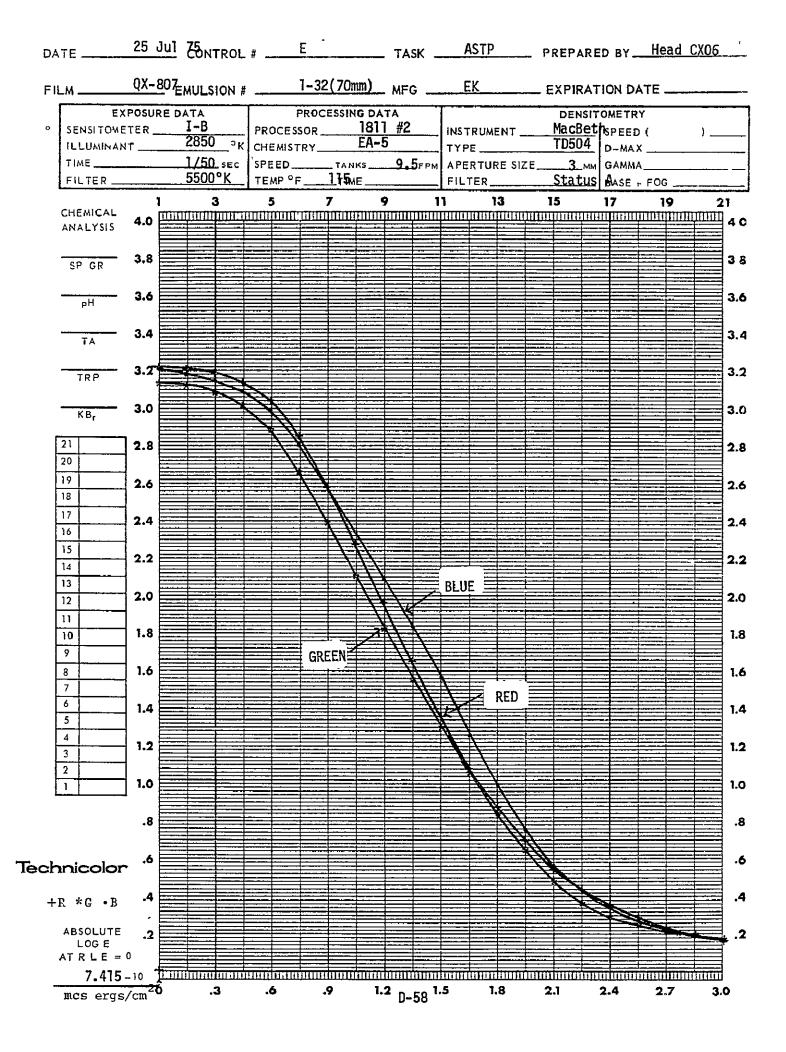
DATE 25 Jul 75 CONTROL # B TASK ASTP PREPARED BY Tail C127

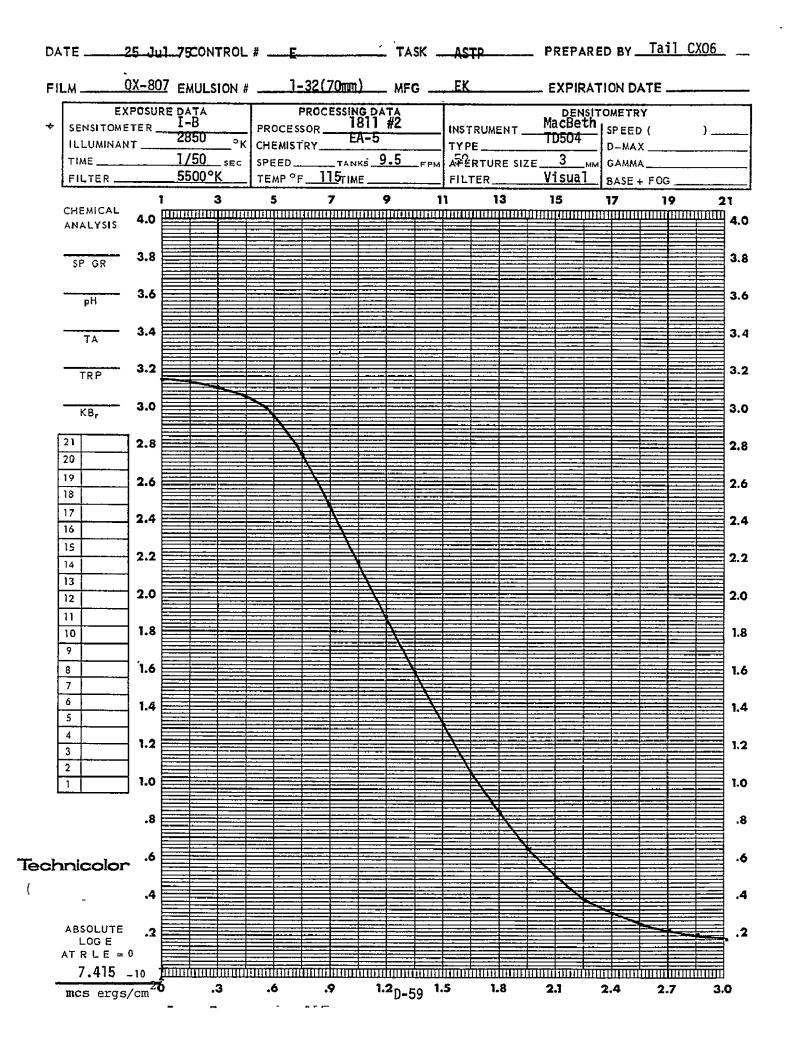


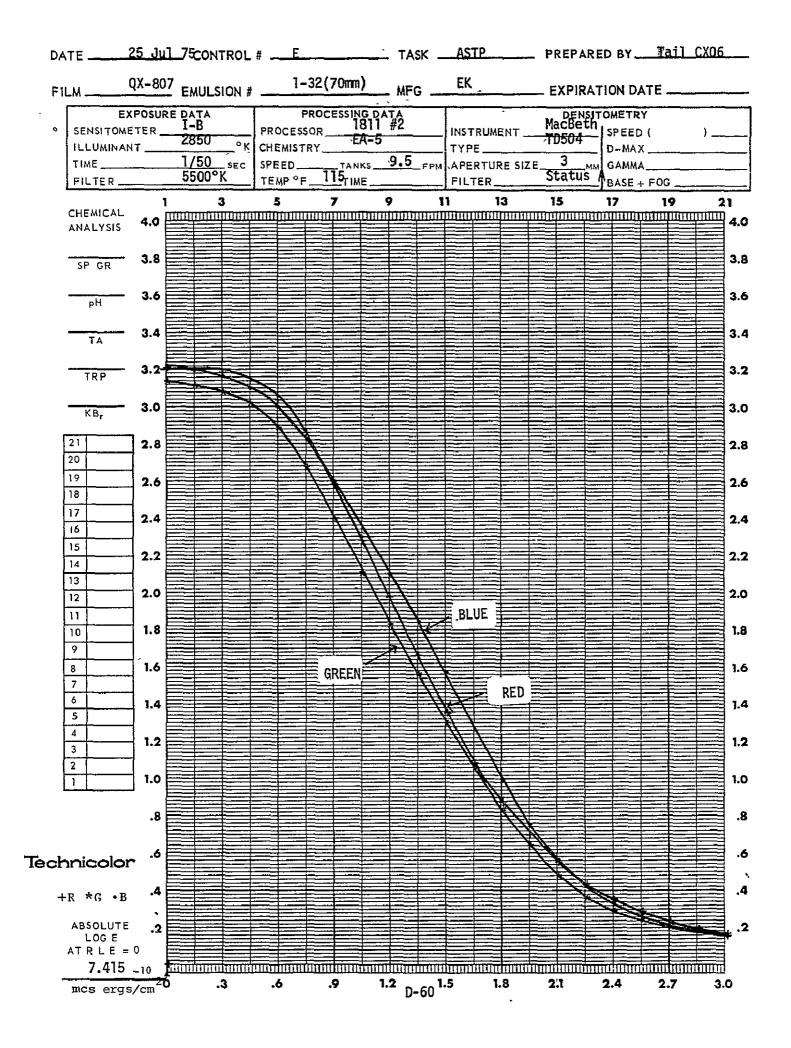


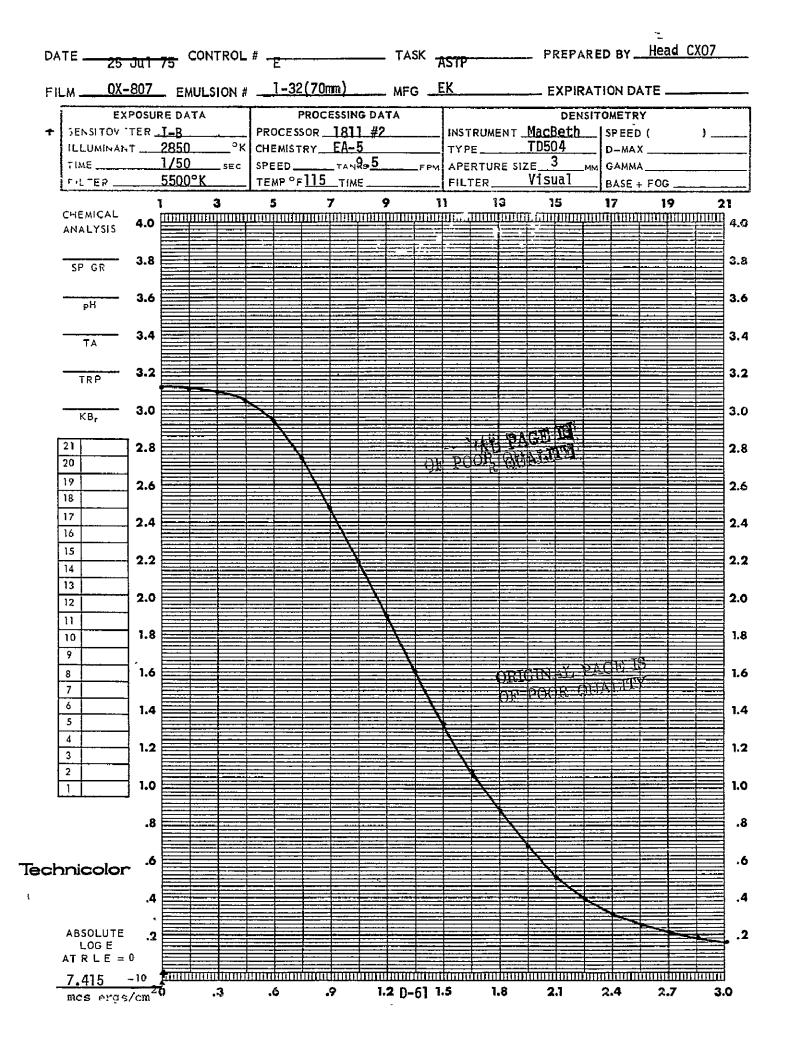
DATE 25 Jul 75 CONTROL # D TASK ASTP PREPARED BY Tail CSO2 FILM <u>0X-806</u> EMULSION # <u>101R</u> MFG <u>EK</u> EXPIRATION DATE ____ EXPOSURE DATA PROCESSING DATA DENSITOMETRY SENSITOMETER I-B PROCESSOR RAM INSTRUMENT MacBeth | SPEED (400) ____ | ILLUMINANT _____2850 __°K CHEMISTRY_______ TYPE ______TD504 D-MAX _____ 1/100__sec TIME _____ SPEED _____ TANKS 62 FPM APERTURE SIZE 3 ____MM GAMMA____ 80D TEMP OF 98 TIME ____ Visual FILTER _ FILTER_ BASE + FOG _ 13 15 1 21 CHEMICAL 4.0 ANALYSIS 3.8 3.5 SP CR 3.6 3.5 ρН 3.4 3.4 TA 3.2 3.2 TRP 3.0 3.0 KB_r 21 2.8 2.8 20 19 2.6 18 17 2.4 2.4 10 15 2.2 2.2 14 13 2.0 2.0 12 11 1.8 1.8 10 9 1.6 8 1.6 7 6 1.4 1.4 5 4 1.2 1.2 3 2 1.0 10 1 .8 .8 .6 ٠. Technicolor .4 .4 ABSOLUTE .2 .2 LOG E -10 mcs ergs/cm²⁰ .3 .6 .9 1.2 D-55 1.5 2.4 2.7 30

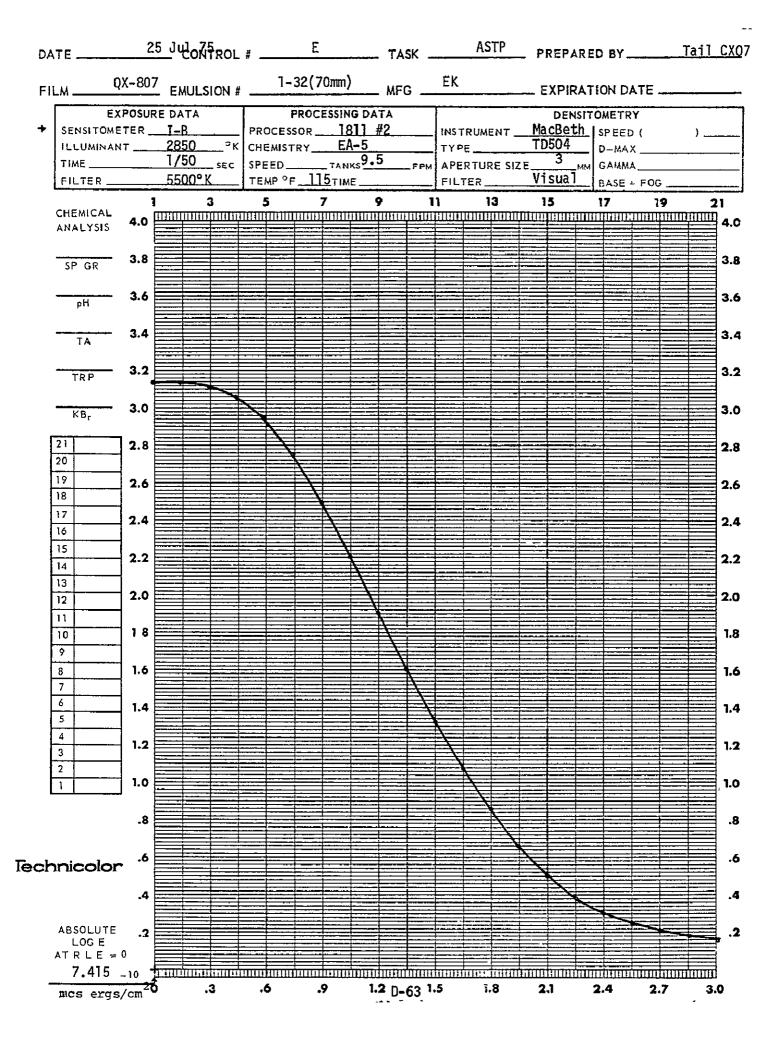


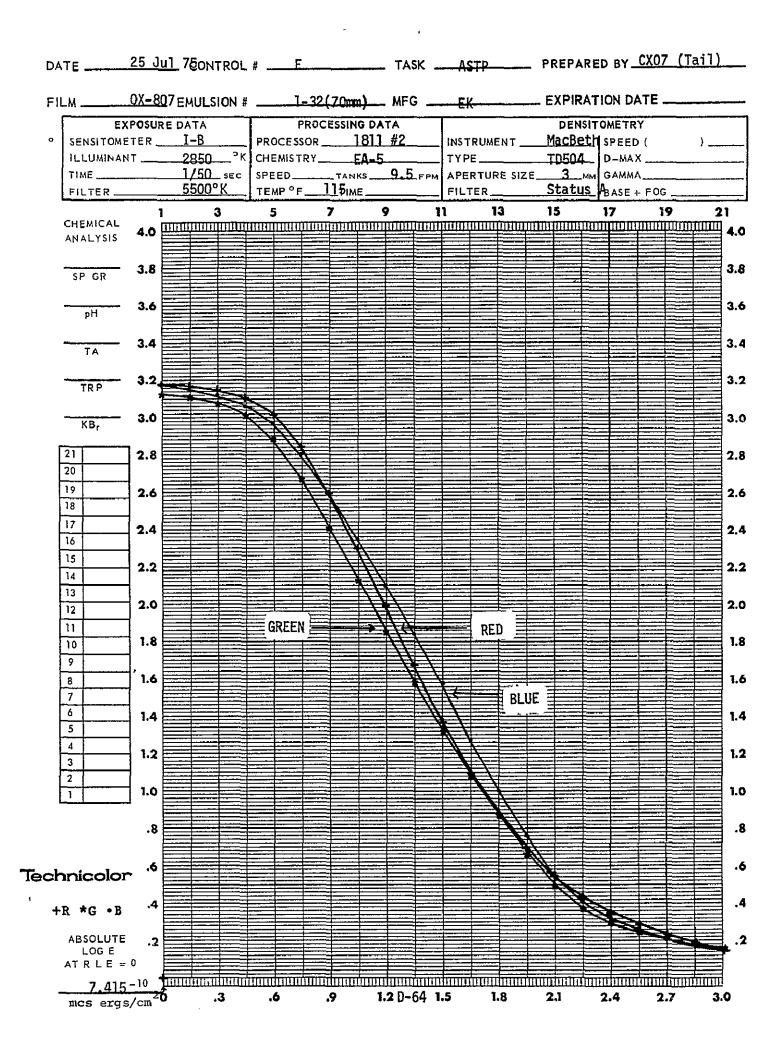




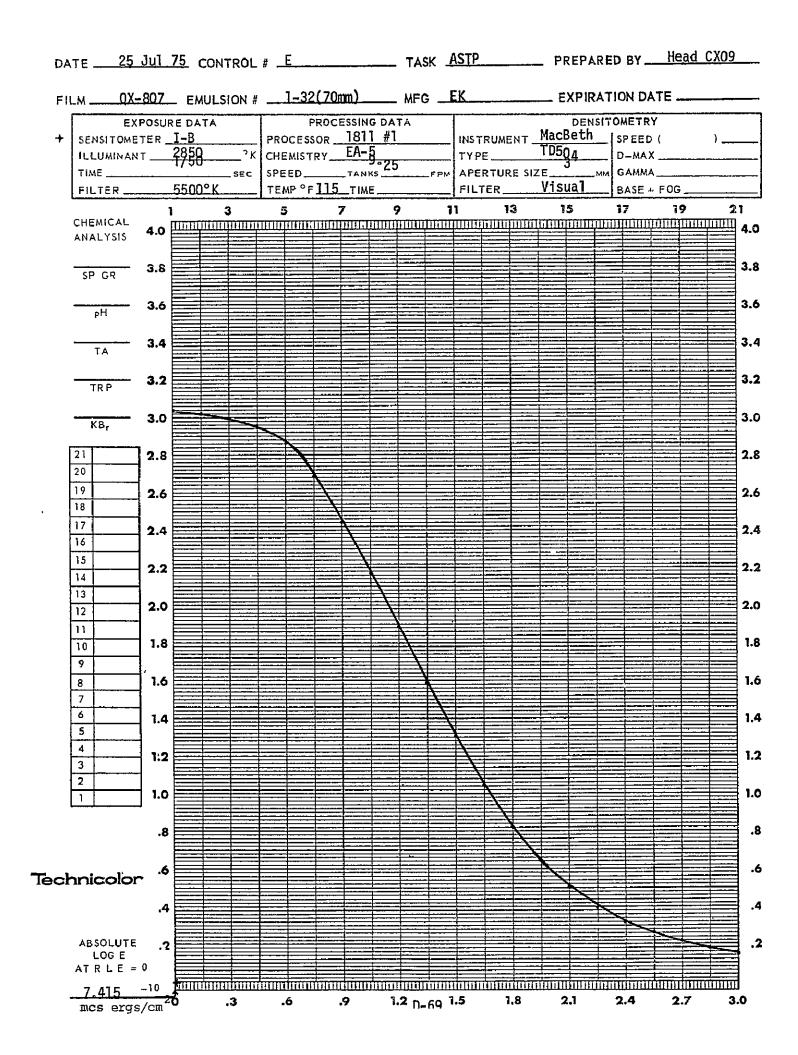


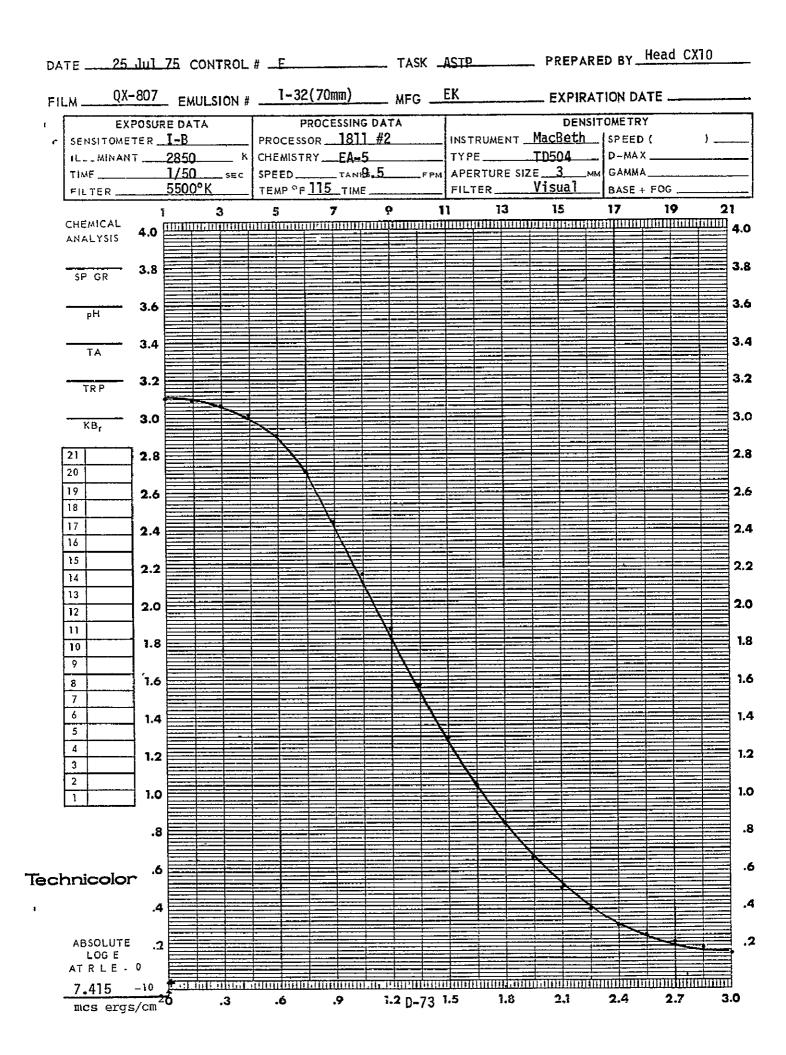


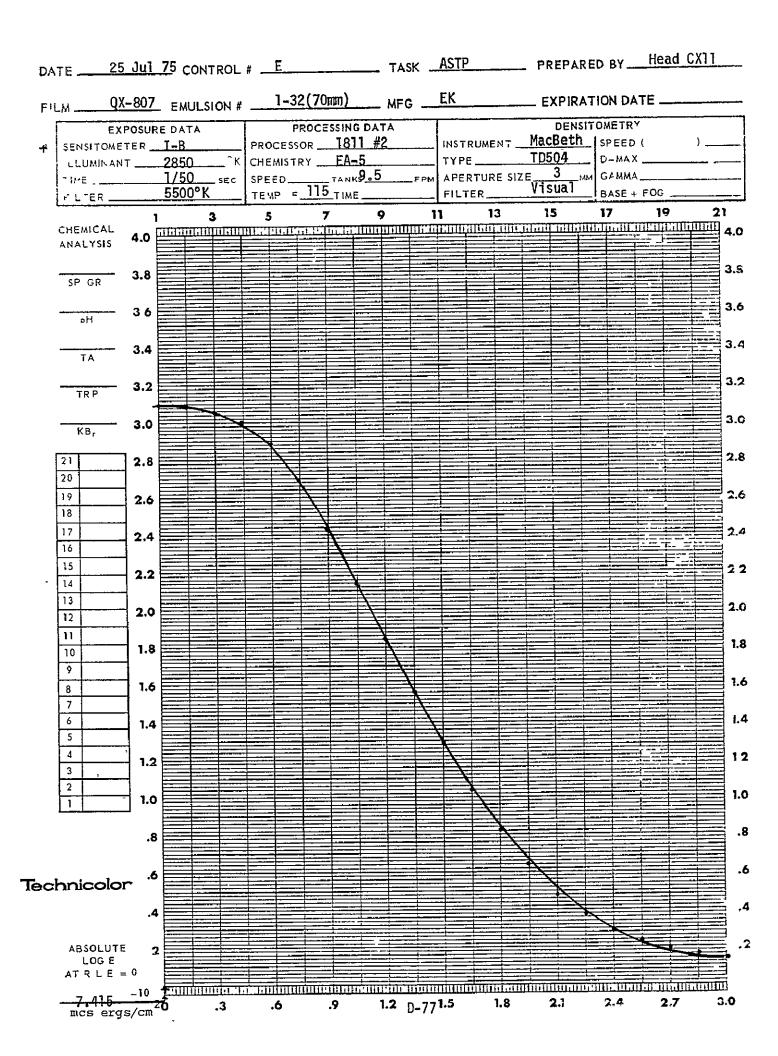


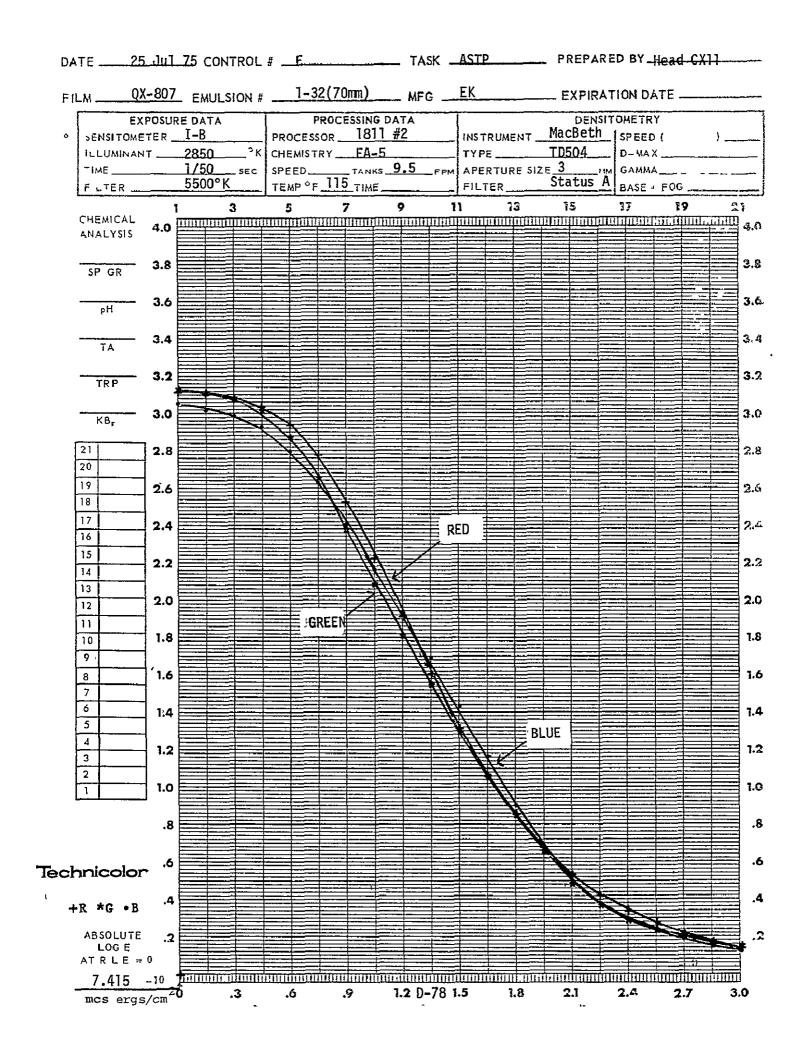


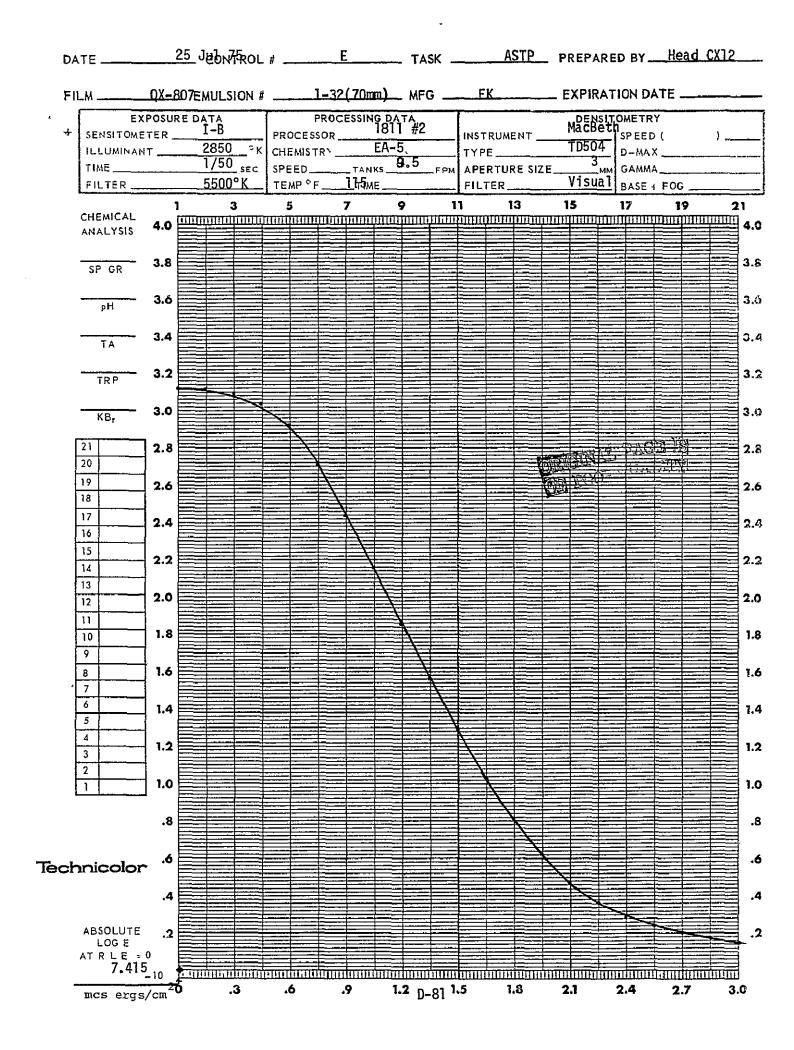
DATE 25 Jul 75 CONTROL # E TASK ASTP PREPARED BY Tail CX08 QX-807 EMULSION # 1-32(70mm) MFG EK EXPIRATION DATE _ PROCESSING DATA DENSITOMETRY EXPOSURE DATA INSTRUMENT MacBeth | SPEED (PROCESSOR 1811 #2 SENSITOMETER I-B TYPE TD504 CHEMISTRY EA-5 D-MAX_____ 1/50 SEC SPEED TANKS 5 FPM APERTURE SIZE 3 MM GAMMA______ TEMP ° F 115 TIME Visual FILTER____ FILTER _____5500°K BASE + FOG ___ 9 11 13 15 17 21 CHEMICAL 4.0 ANALYSIS 3.8 3.8 SP GR 3.6 3.6 ρН 3.4 3.4 3.2 TRP 3.0 3.0 KB, 21 2.8 2.8 20 2.6 18 ORIGINAL PACTO IS 17 2.4 2.4 16 15 2.2 2.2 14 13 2.0 2.0 12 1.8 1.8 10 1.6 1.6 8 1.4 1.4 -4 1.2 1.2 3 1.0 1.0 .8 .8 .6 Technicolor .4 ABSOLUTE .2 LOG E ATRLE = 0 2.1 2.4 .6 .9 1.2 D_67 1.5 1.8 mcs ergs/cm²⁰

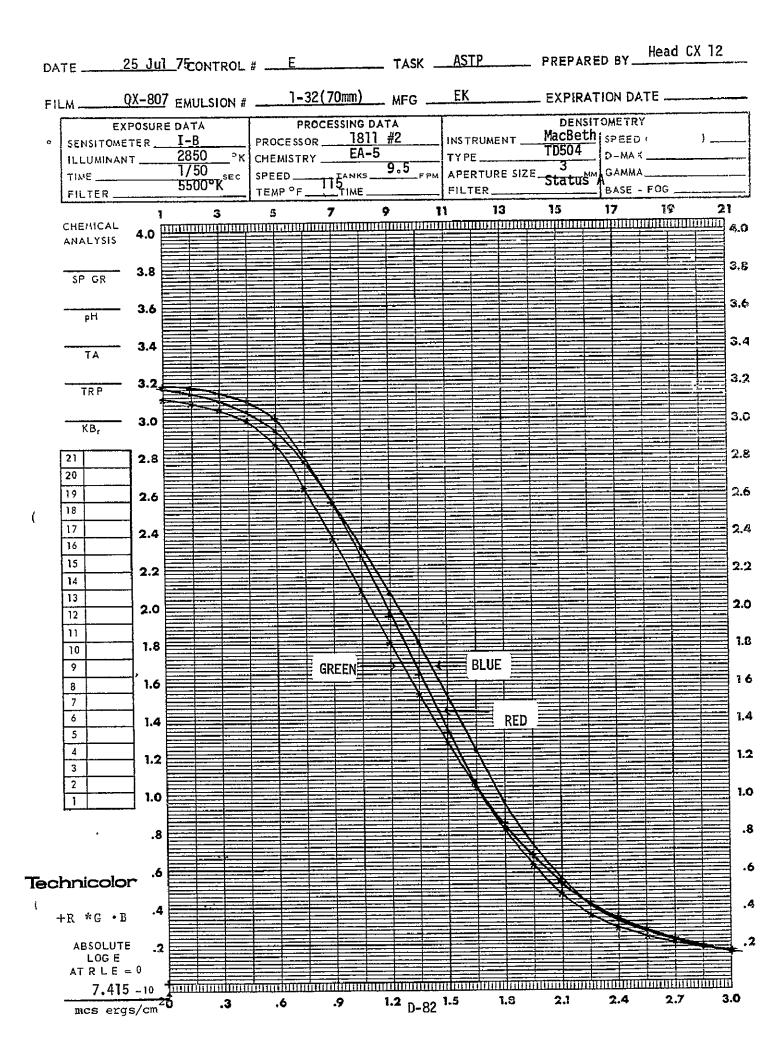


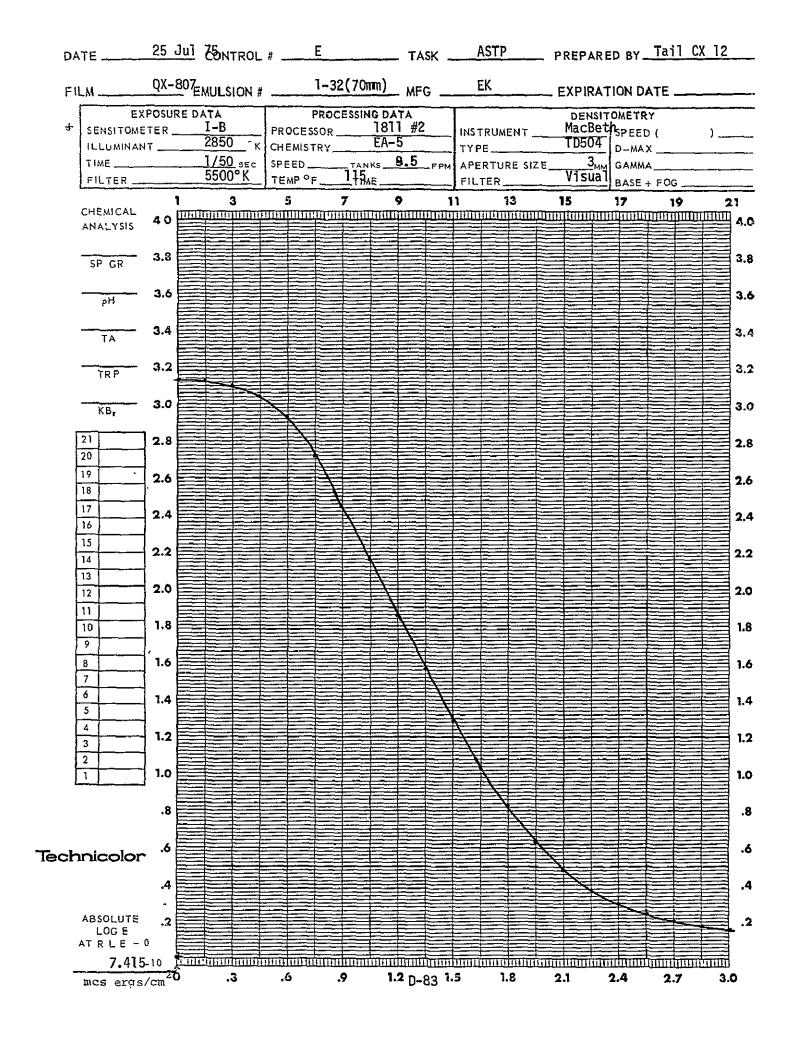


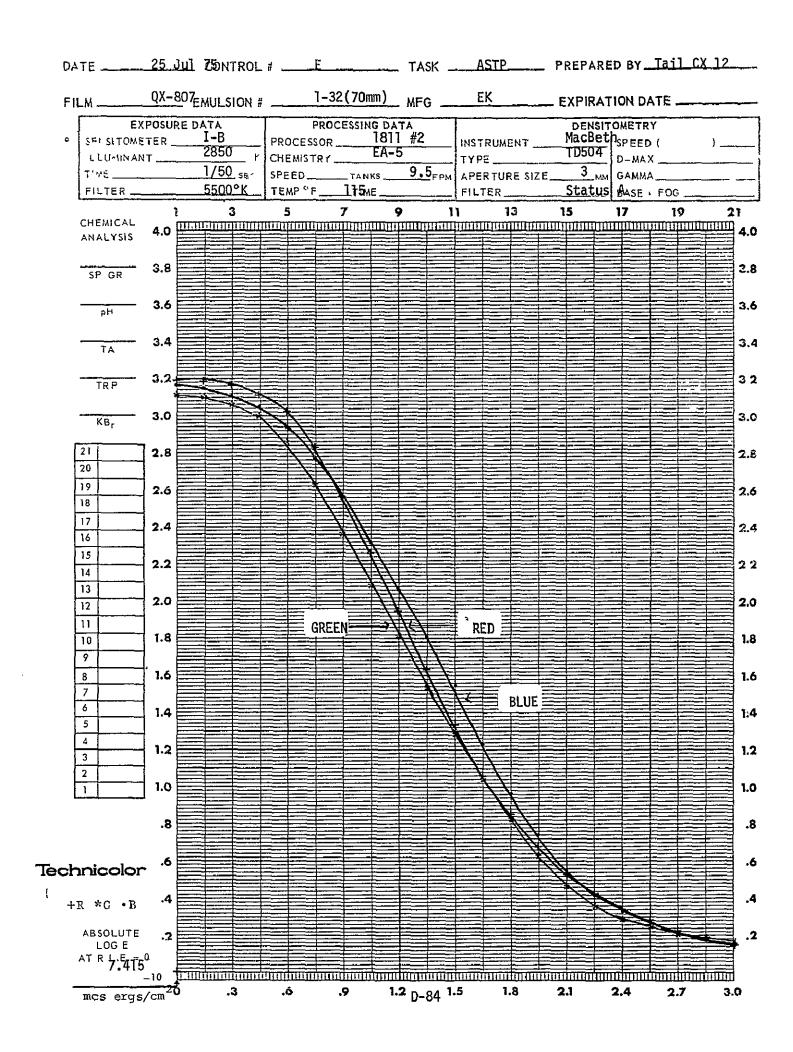


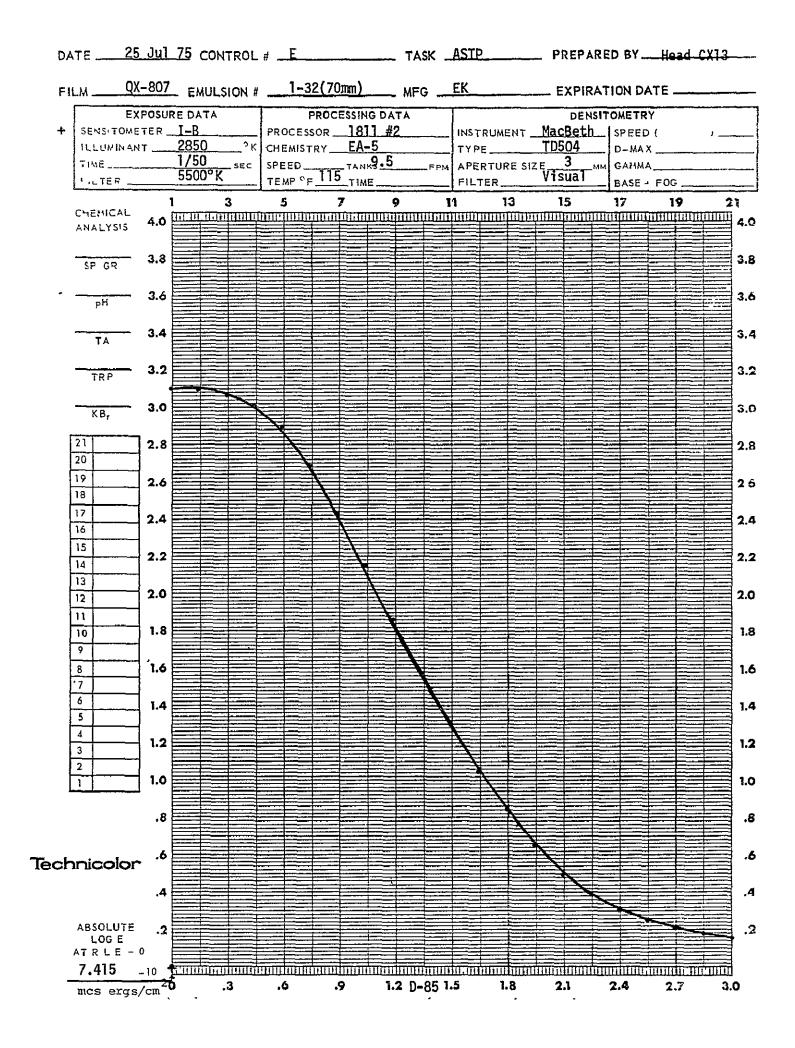


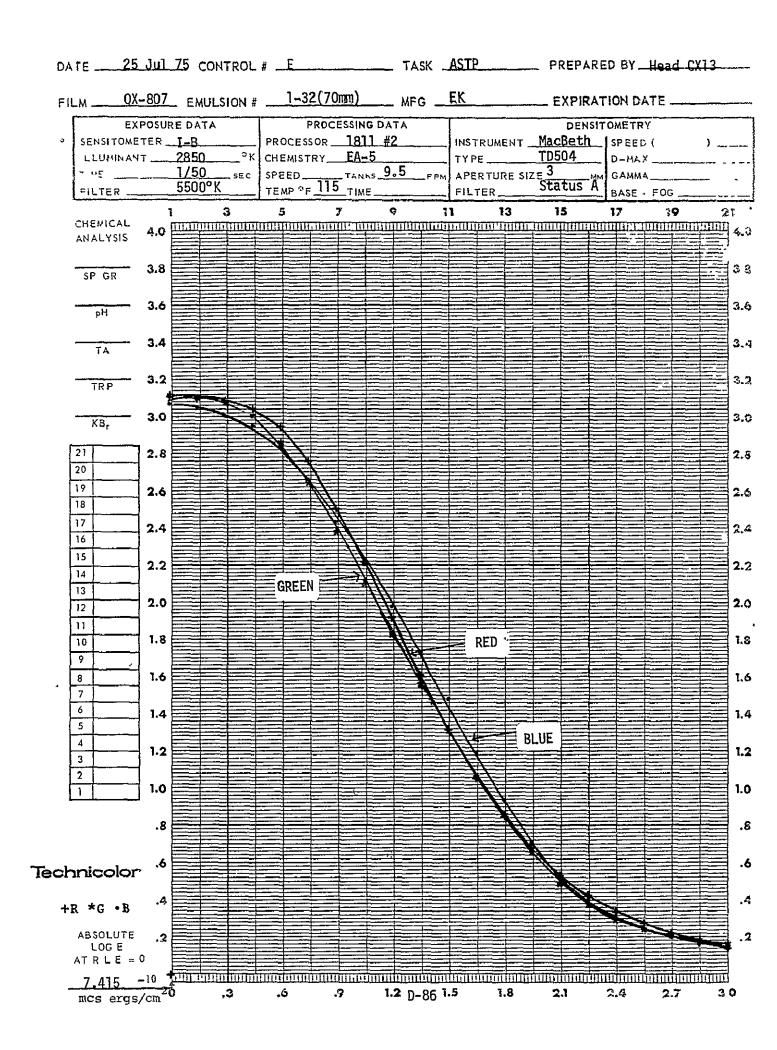


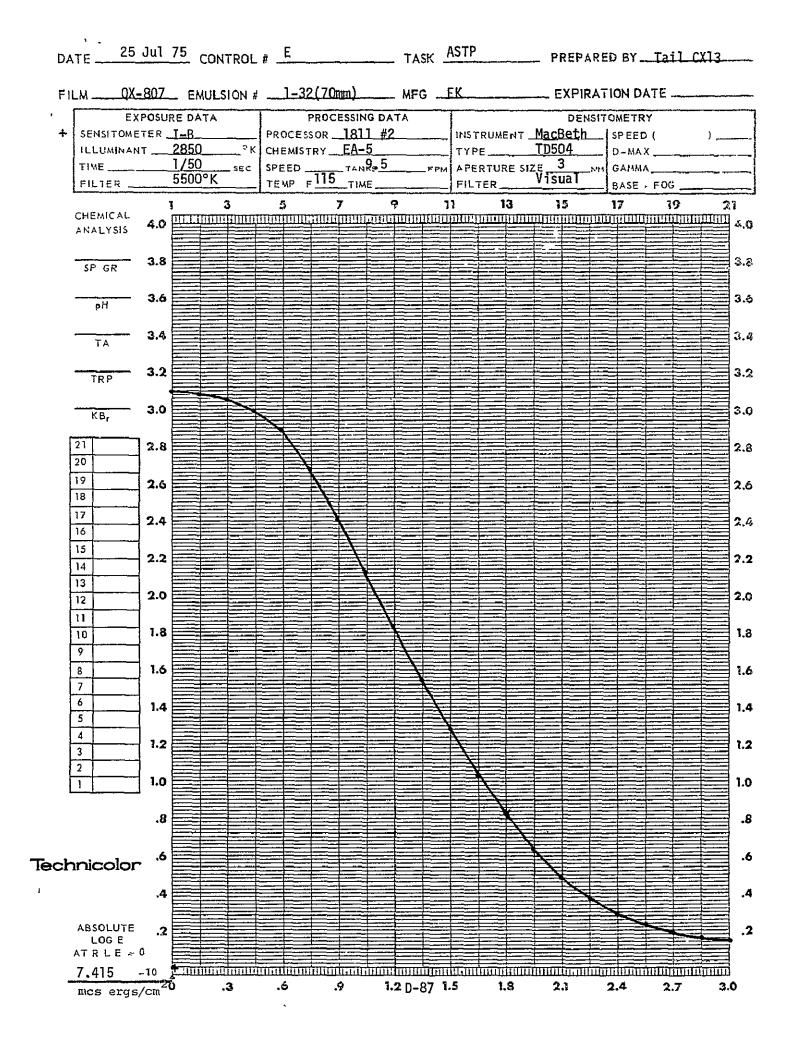


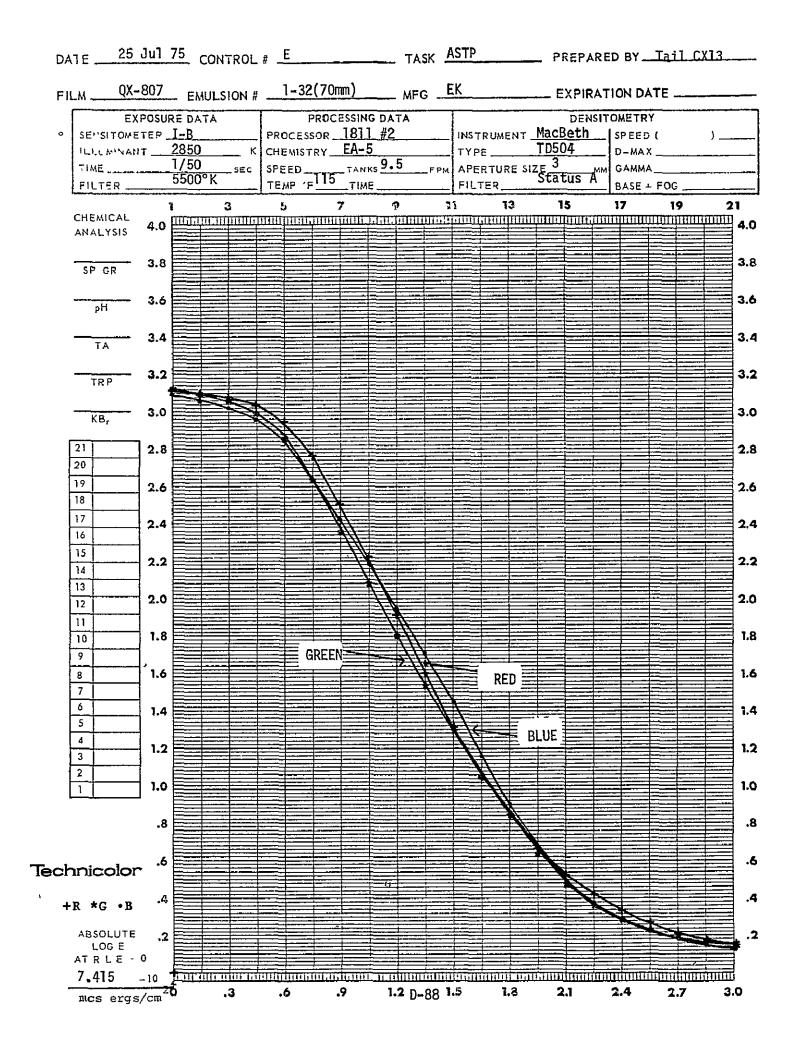


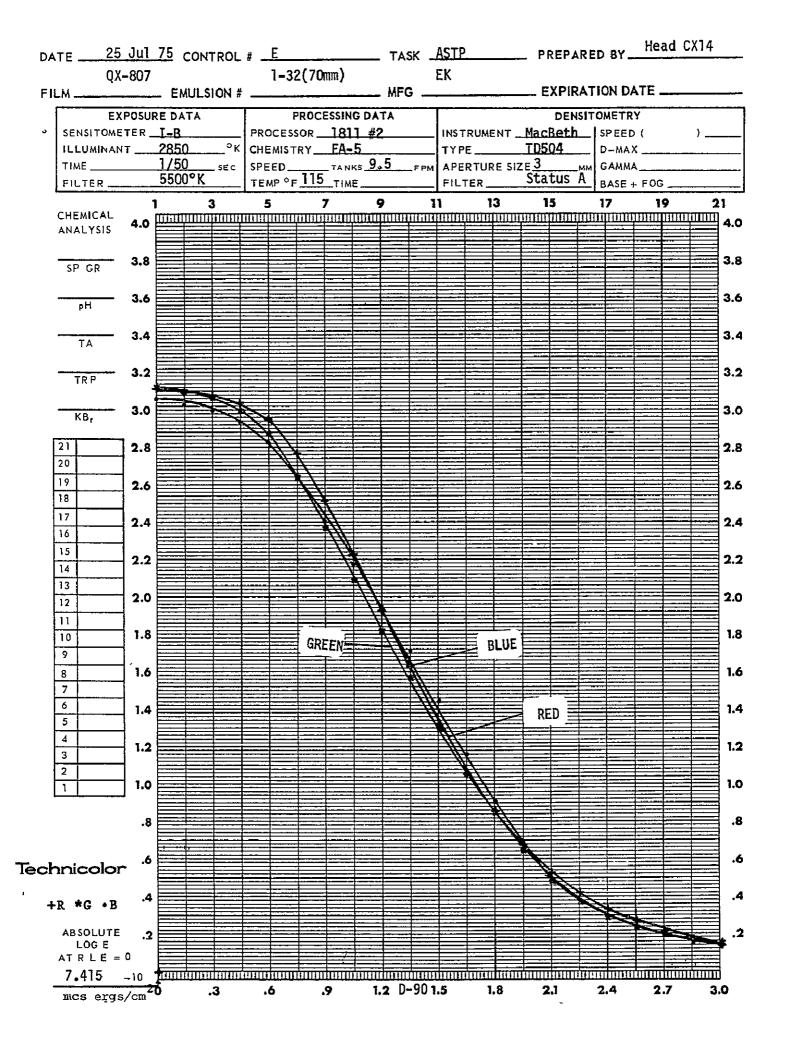


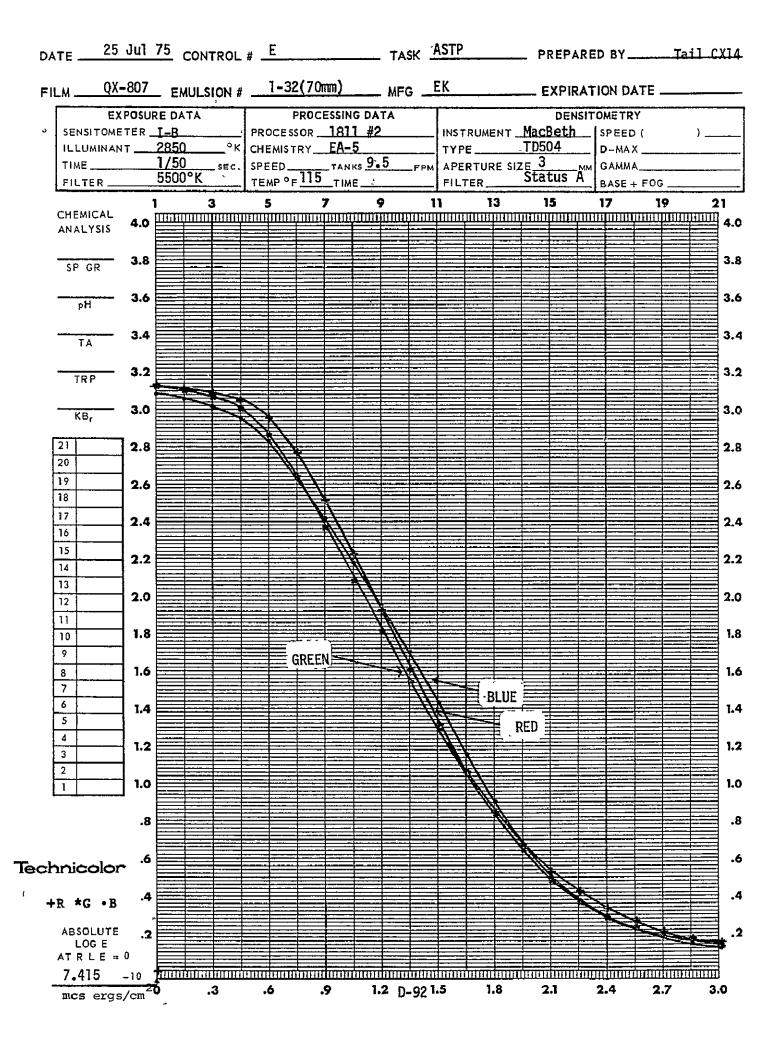


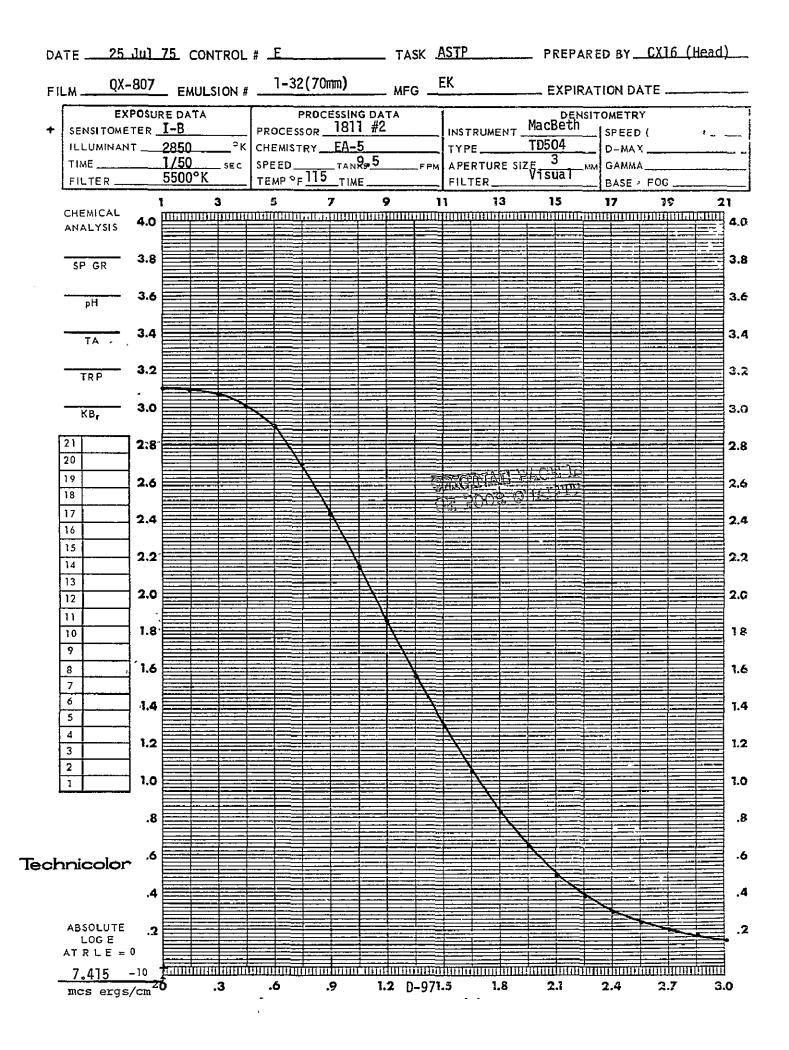




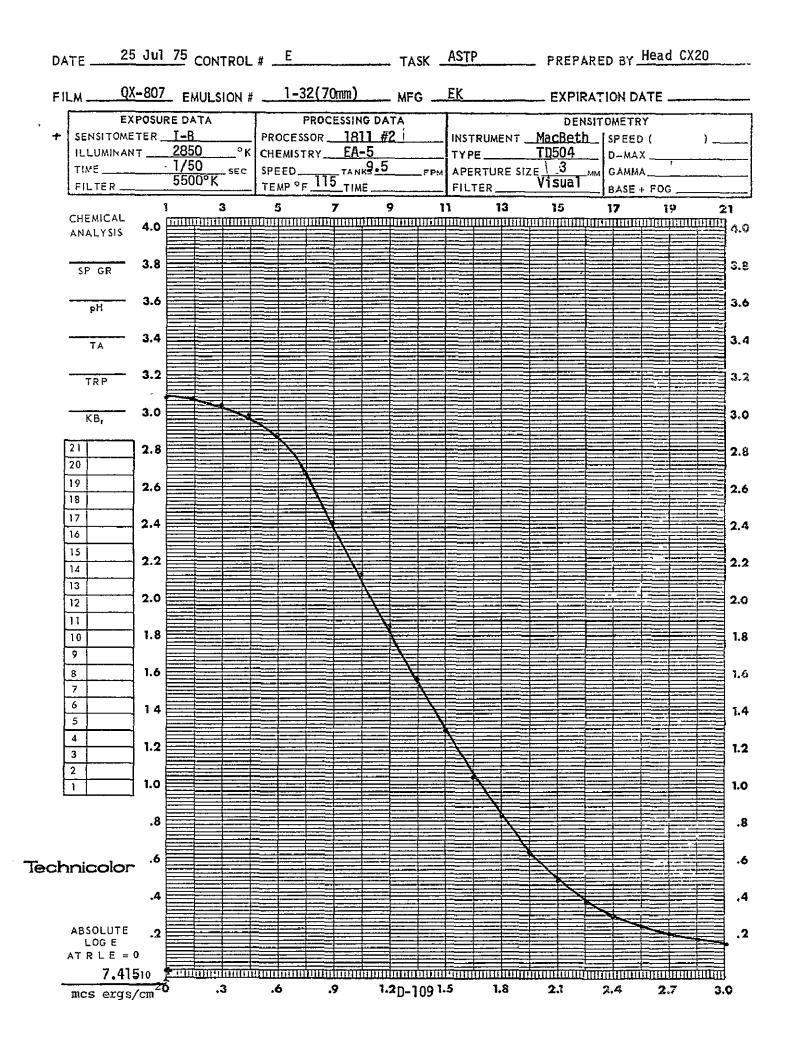


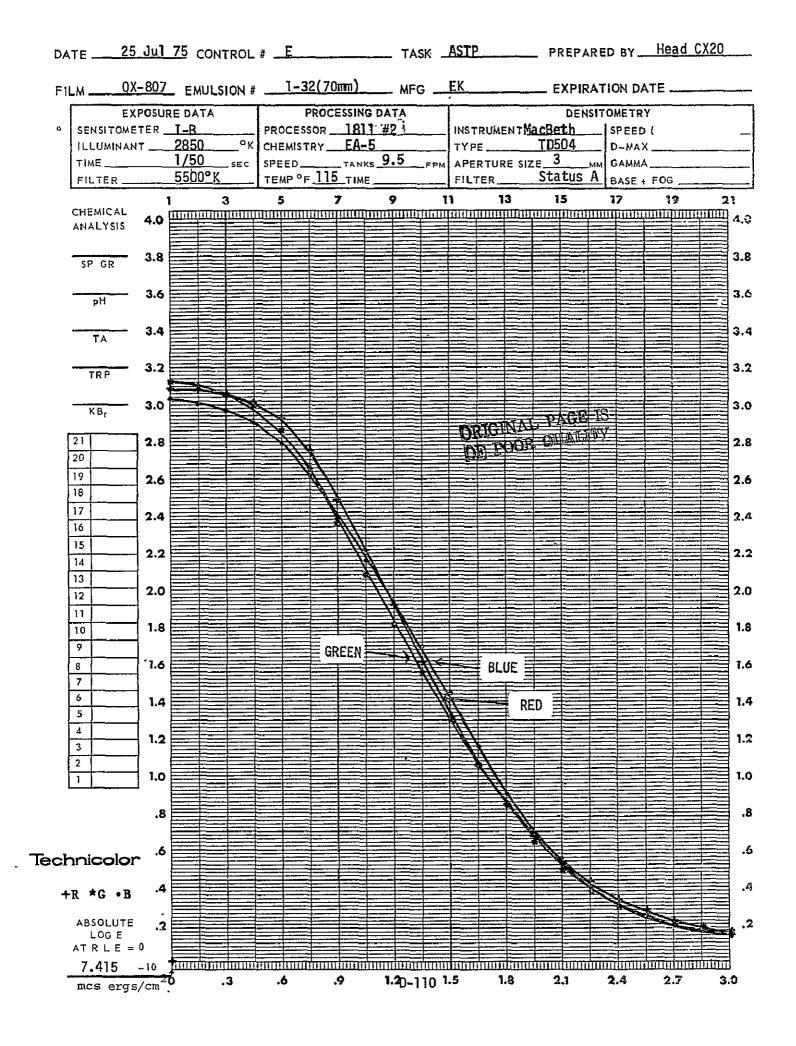




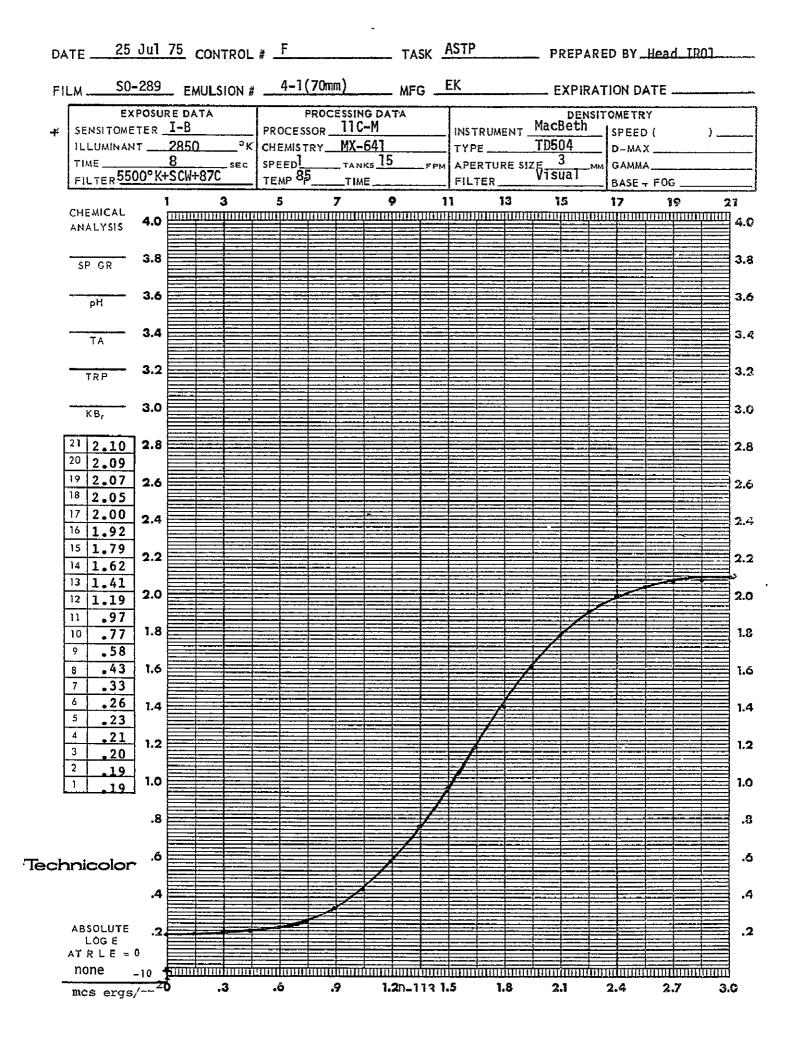


DATE 25 Jul 75 CONTROL # E TASK ASTP PREPARED BY Tail CX19

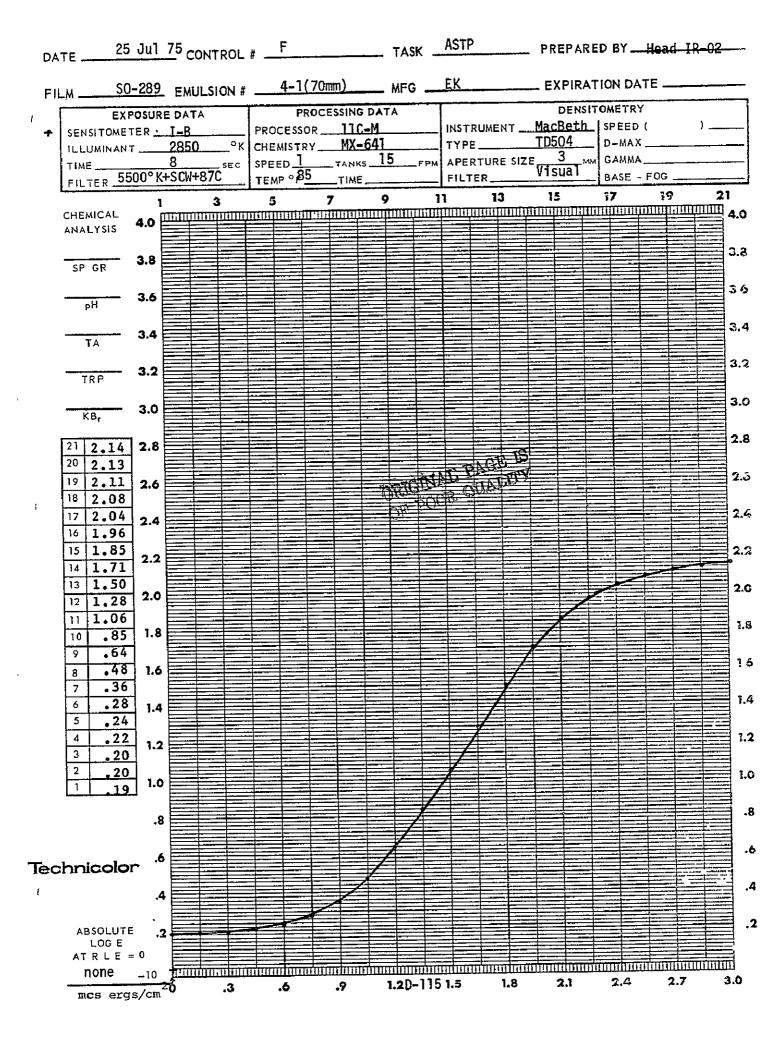


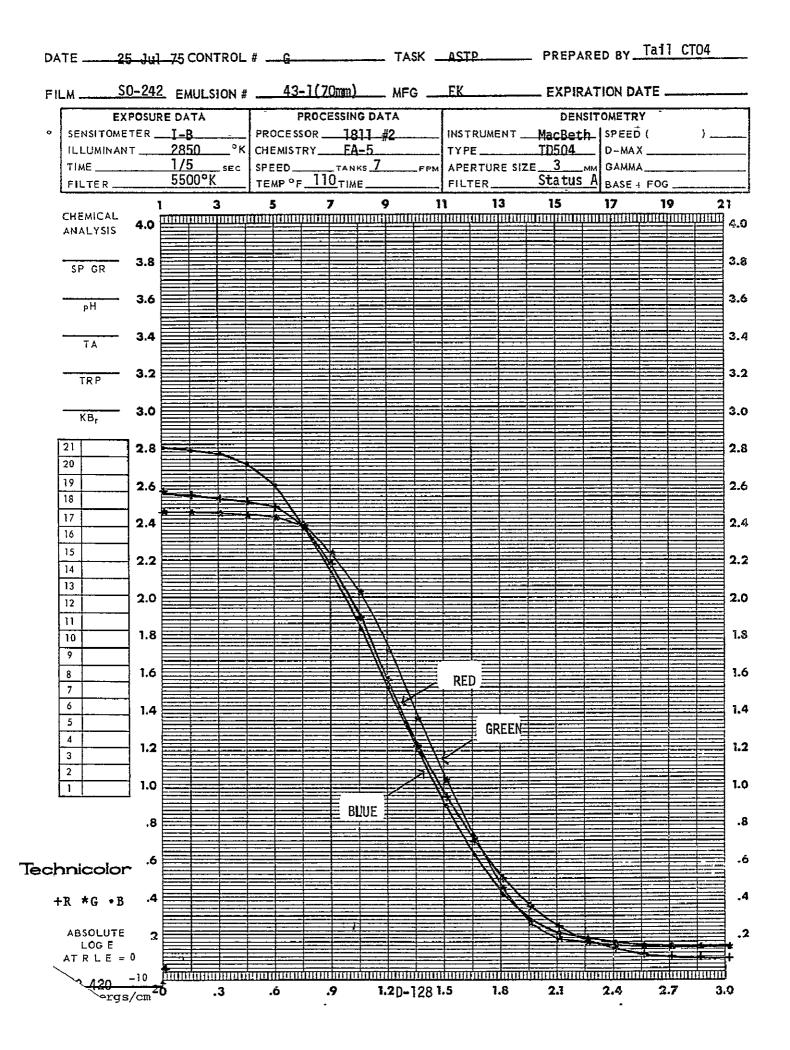


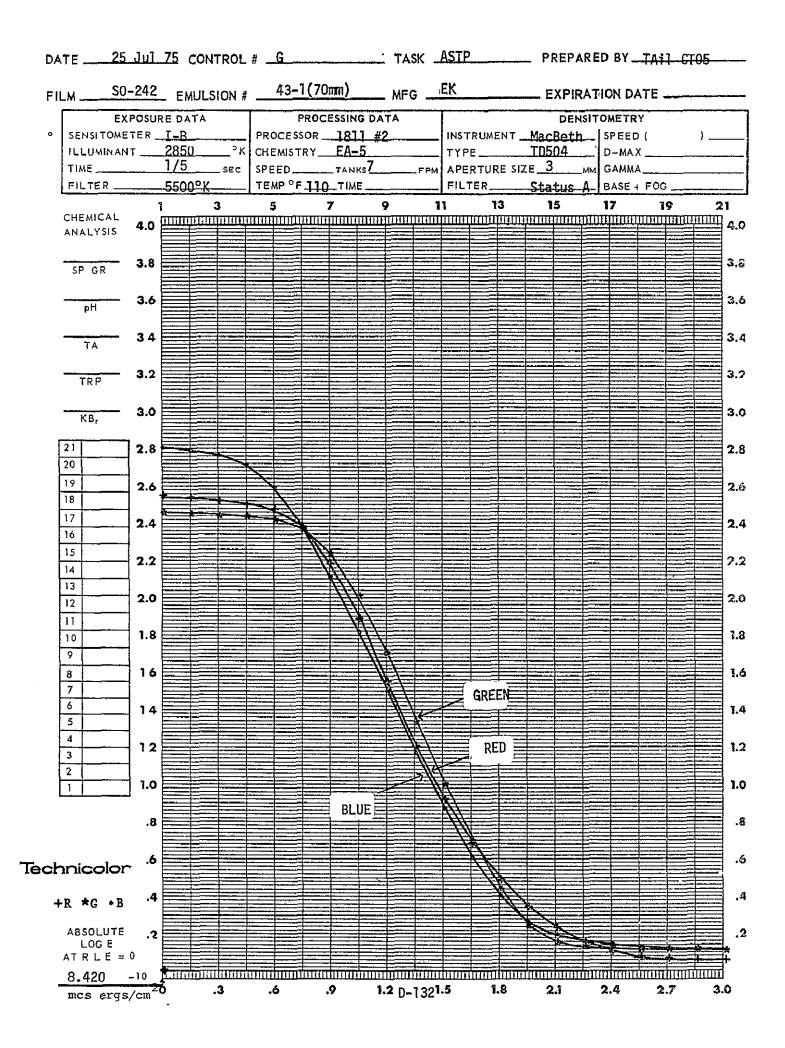
DATE 25 Jul 75 CONTROL # E TASK ASTP PREPARED BY Tail CX20

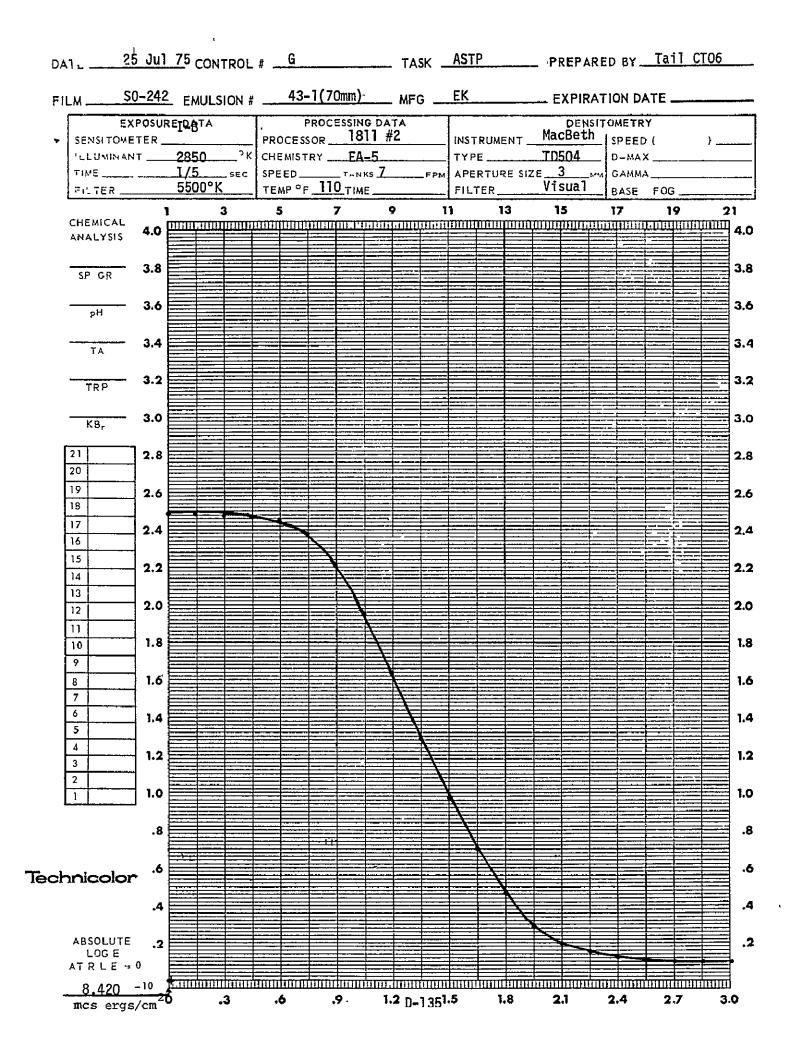


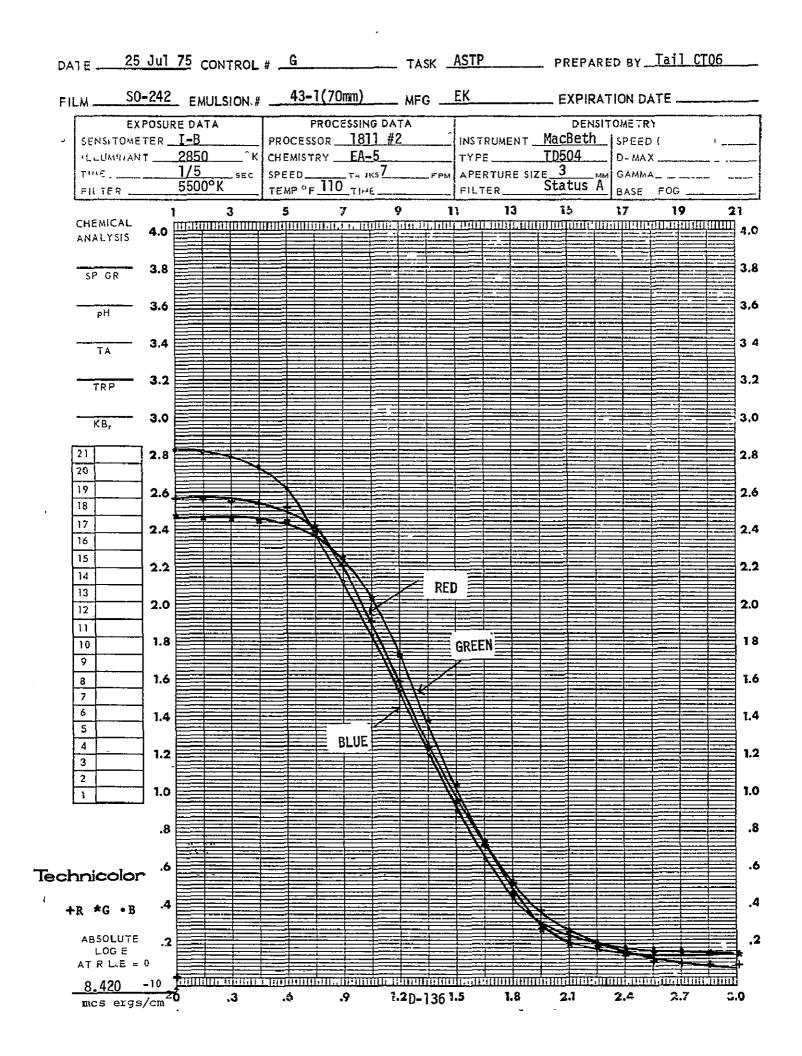
DATE 25 Jul 75 CONTROL # F TASK ASTP PREPARED BY Tail IROI SO-289 EMULSION # 4-1(70mm) MFG EK EXPIRATION DATE __ FILM __ EXPOSURE DATA DENSITOMETRY PROCESSING DATA SENSITOMETER __ I-B PROCESSOR 11C-M INSTRUMENT MacBeth | SPEED (ILLUMINANT ____ 2850 ___ °K CHEMISTRY MX-641 TD504 TYPE ____ D-MAX_ APERTURE SIZE 3 SPEED 1 TANKS 15 T-WF______ 8 __ SEC GAMMA ... FILTER 5500°K+SCW+87C TEMP 85 <u>Visual</u> FILTER ___ BASE + FOG 17 CHEMICAL 4.0 ANALYSIS 3.8 3.8 SP GR 3.6 3.6 ρН 3.4 3,4 TA 3.2 3.2 TRP 3.0 3.0 КB_г 2.8 2.8 2.6 2.6 .99 2.4 2.4 16 15 2.2 2.2 . 39 2.0 2.0 12 _17 11 96 1.8 1.8 10 .75 9 .57 1.6 1.6 42 7 .32 6 25 1.4 1.4 .22 20 1.2 1.2 3 . 19 . 19-1.0 1.0 .18-.8 .8 ٠ć Technicolor .4 ABSOLUTE .2 LOG E ATRLE = 0ប្រាសាសាស្រានស្រានស្រានស្រានស្រានសម្រានសម្រានសម្រានសម្រានសម្រានសម្រានសម្រានសម្រានសម្រានសម្រានសម្រានសម្រាន -10 .6 9 1.2D-114 1.5 1.6 2.7 2.4 27 mcs ergs/cm²⁰ 3.0

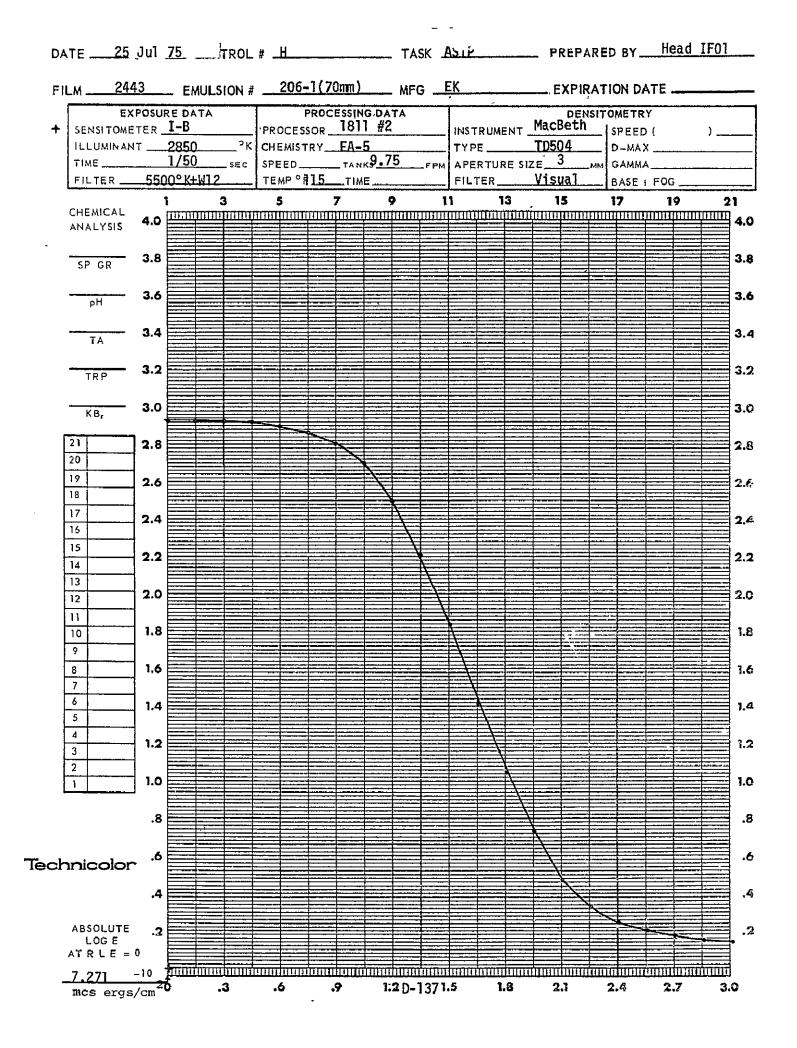


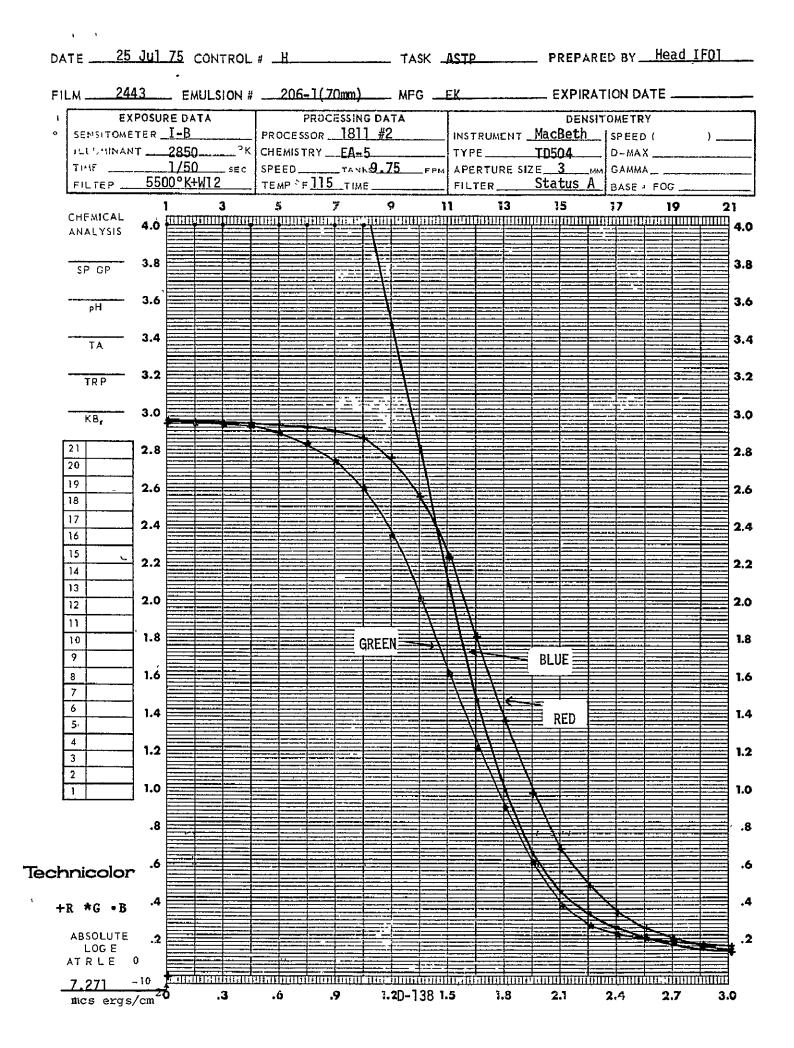


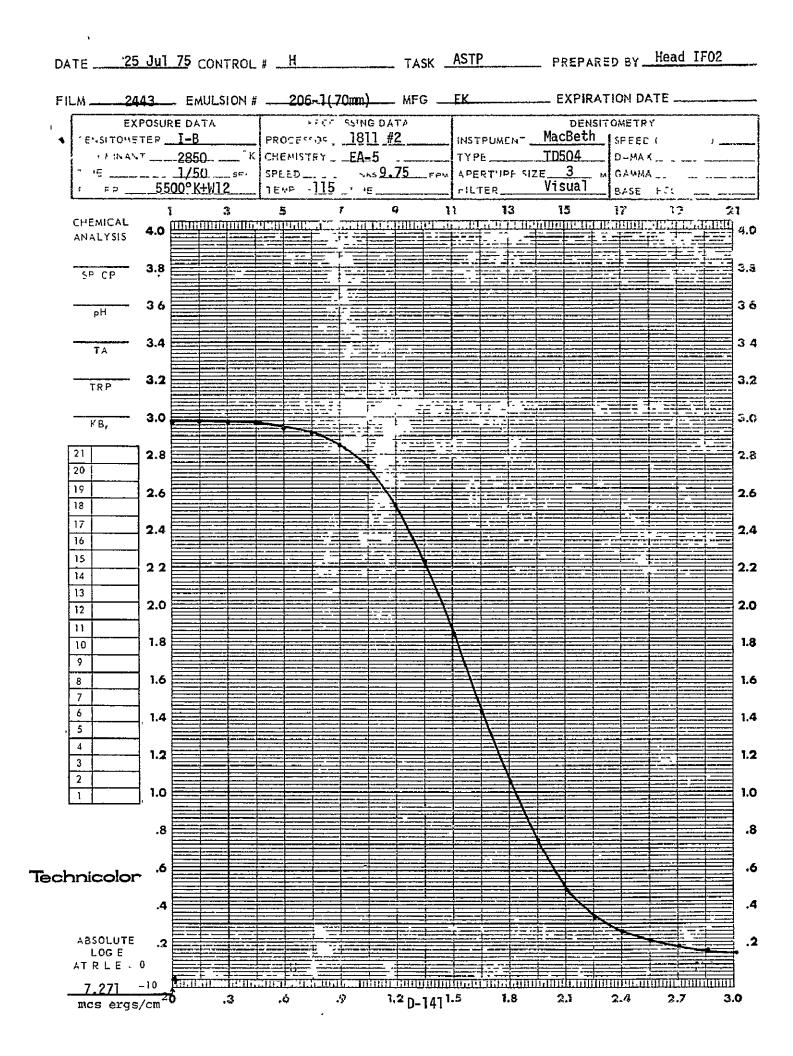


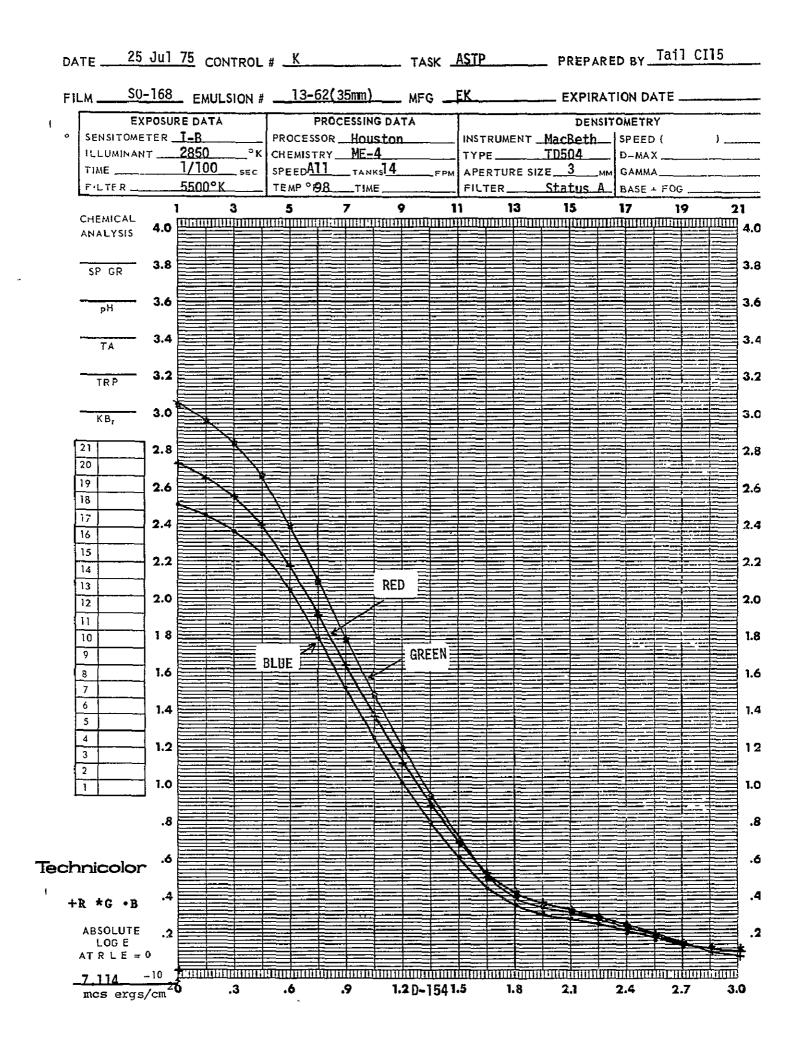












DATE 25 Jul 75 CONTROL # K TASK ASTP PREPARED BY Tail CI18 S0-168 EMULSION # 13-62(35mm) MFG EK EXPIRATION DATE __ FILM ___ PROCESSING DATA EXPOSURE DATA DENSITOMETRY SENSITOMETER I-B PROCESSOR Houston INSTRUMENT MacBeth SPEED (ILLUMINANT _____2850 _°K CHEMISTRY ME-4 TD504 TYPE____ D-MAX_ 1/100 SEC SPEEDALL TANKS 4 FPM APERTURE SIZE 3 MM GAMMA TIME__ 5500°K TEMP 0 8 ____TIME ____ FILTER _ <u>Status A</u> FILTER____ BASE + FOG _ 7 0 11 13 15 17 19 21 4.0 попринения принения принен CHEMICAL ANALYSIS 3.8 SP GR 3.6 3.6 рΗ 3.4 3.4 TA 3.2 3.2 TRP 3.0 3.0 KB, 2.8 2.8 20 19 2.6 2.6 18 17 2.4 2.4 16 15 2.2 2.2 14 GREEN 13 2.0 2.0 12 11 1.8 RED 1.8 10 9 BLUE 1.6 8 1.6 7 6 1.4 1.4 5 4 1.2 1.2 3 1.0 1.0 .8 .8 Technicolor +R *G •B **ABSOLUTE** .2 LOG E ATRLE = 0 7.114 .3 .6 .9 1.2 D-1601.5 1:8 2.1 2.4 2.7 3.0 mcs ergs/cm

DATE 25 Jul 75 CONTROL # K TASK ASTP PREPARED BY Tail CI20 FILM S0-168 EMULSION # 13-62(35mm) MFG EK EXPIRATION DATE EXPOSURE DATA PROCESSING DATA DENSITOMETRY SENSITOMETER _ I-B. INSTRUMENT MacBeth | SPEED (PROCESSOR Houston) ___ ___ °K CHEMISTRY ME-4 ILLUMINANT _____ 2850 TD504 TYPE ____ D-MAX __ 1/100 SEC | SPEEDALL TANKS 4 FPM APERTURE SIZE 3 MM GAMMA___ 5500°K TEMP P8_TIME_ Visual FILTER___ BASE + FOG . 7 5 9 11 13 15 CHEMICAL ANALYSIS 3.8 3.8 SP GR 3.6 3,6 ρН 3.4 3.4 TA 3.2 3.2 TRP 3.0 3.0 KB, 21 2.8 2.8 20 19 2.6 2.6 18 17 2.4 2.4 16 15 2.2 2.2 14 13 2.0 2.0 12 11 1.8 10 1.8 9 1.6 8 1.6 7 6 1.4 1.4 5 4 1.2 1.2 3 2 1.0 1.0 .8 .8 .6 Technicolor .4 .4 **ABSOLUTE** .2 .2 LOG E ATRLE = 0 7.114 իրավարակացին ավագինական հայանականի արկարգին անկարական անկան արգահանական արկան արկան անկարկան հայանական հայանակա -10 .3 .6 1.2 _{D-161} 1.5 1.8 2.1 2.4 2.7 3.0 mcs ergs/cm²⁰